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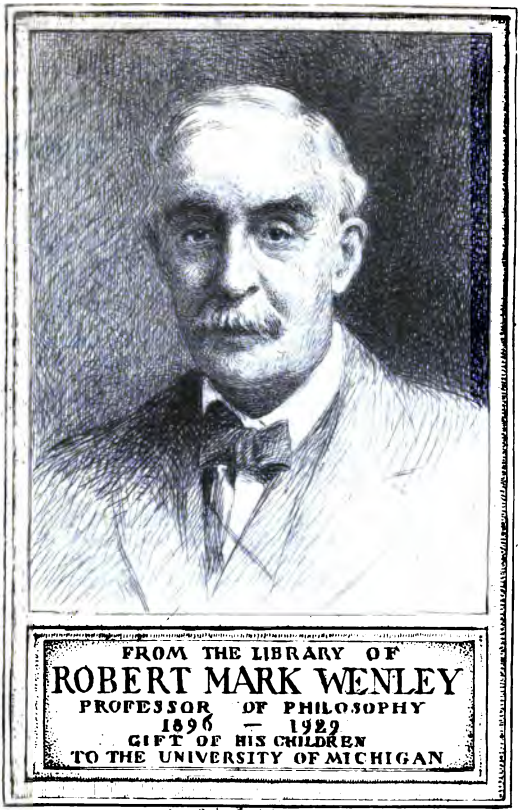

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PREFACE TO THE FIRST ISSUE.

THE foundation of UNIVERSITY COLLEGE, DUNDEE, may be said to be one of the latest results of that movement for the extension of liberal education and the advancement of technical instruction which has made such rapid progress within the last ten or twelve years. In Manchester the Victoria University has been developed out of the more modest beginnings of the Owens College; while at Leeds, Newcastle, Bristol, Sheffield, Birmingham, Nottingham, and Liverpool local Colleges have from time to time sprung up, with the twofold aim of bringing the advantages of higher education within the reach of those who cannot make use of existing University centres, and also of preparing for the Degree Examinations of such Universities as grant Degrees to non-resident Students.

As early as December 1874 Dr John Boyd Baxter submitted for the consideration of the Magistrates and Town Council a comprehensive scheme, showing how a College might be started in Dundee, with six Professorships, at a cost of £150,000, and how the necessary development might afterwards be secured at a cost of £75,000 more. The scheme was variously canvassed; but though, for several reasons, it ultimately fell to the ground, it produced two very beneficial results. In the first place, it called attention to the need for higher education in Dundee; and, secondly, it elicited a pretty general expression of opinion that the work done by the College should embrace both the Arts and the Sciences.

The munificence of Miss Baxter of Balgavies enabled Dr Baxter, six years later, to revive the essential features of the scheme—this time with greater success. Accordingly at a meeting of the Directors of the High School, on the

22d December 1880, Dr Baxter announced that he was empowered to offer the sum of £120,000 as a subscription by Miss Baxter towards the institution of a College in Dundee which should have the same aims as the Owens College, Manchester. This sum was afterwards increased to £140,000, by Dr Baxter's own contribution of £10,000, and by a further subscription of £10,000 from Miss Baxter. Of the sum total, £100,000 has been appropriated as a permanent endowment fund, and the balance has been expended on the purchase and adaptation of properties in a central part of the town. Finally, in January 1883 Miss Baxter intimated to the Council an additional subscription of £10,000, for the purpose of erecting a new Chemical Laboratory, and furnishing it with the necessary fittings and apparatus.

The Deed of Endowment and Trust directs the Trustees to apply the means put in their hands to "founding, establishing, endowing, maintaining, and conducting a College for promoting the education of persons of both sexes, and the study of Science, Literature, and the Fine Arts;" and it is specified as a fundamental condition "that no Student, Professor, Teacher, or other officer or person connected with the College, or the operations thereof, shall be required to make any declaration as to his or her religious opinions, or to submit to any test of his or her religious opinions, and that nothing shall be introduced in the manner or mode of education or instruction in reference to any religious or theological subject which can reasonably be considered offensive to the conscience."

The Deed further provides that the Authorities of the College shall consist of (1) The Governors; (2) the Council; (3) the Education Board.

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JUNE 1883.

Calendar.

CALENDAR.

SEPTEMBER—1889.		
1	S	
2	M	College Library re-opens.
3	Tu	
4	W	
5	Th	
6	F	
7	S	
8	S	
9	M	
10	Tu	
11	W	Council meets.
12	Th	Professor Paterson elected, 1888.
13	F	
14	S	
15	S	
16	M	
17	Tu	
18	W	
19	Th	
20	F	
21	S	
22	S	
23	M	Last day for sending in Certificates for London B.Sc.
24	Tu	[Exam.
25	W	
26	Th	
27	F	
28	S	
29	S	
30	M	Last day for sending in names for College Scholarship [Exams. Last day for sending in Certificates [for London B.A. and M.B. Exams.

SEPTEMBER—1889.

1 S

2 M
3 Tu
4 W
5 Th
6 F
7 S
8 S

9 M
10 Tu
11 W
12 Th
13 F
14 S
15 S

16 M
17 Tu
18 W
19 Th
20 F
21 S
22 S

23 M
24 Tu
25 W
26 Th
27 F
28 S
29 S

30 M

OCTOBER—1889.

1	Tu	Candidates for Degrees at St Andrews give in names, &c.,
2	W	College Opened 1883. [by this day.
3	Th	Examination for Armitstead Scholarships—9 A.M. Examination continued—9 A.M.: Smart Bursary—9 A.M.
4	F	Registration from 7 to 9 P.M.
5	S	Entrance Exam. for Students under Sixteen—10 A.M.
6	S	[Regis. con.—11 A.M. to 2 P.M. and from 7 to [Inaugural Address, 8 P.M. [9 P.M.
7	M	First Term begins.
8	Tu	Education Board meets, 2.30 P.M.
9	W	Council meets.
10	Th	
11	F	
12	S	
13	S	
14	M	Preliminary Examinations in Science and Medicine at
15	Tu	[St Andrews.
16	W	Statutory Meeting of Governors falls to be held on a
17	Th	[day in this week.
18	F	
19	S	
20	S	[Examinations begin.
21	M	London B.Sc. Examination begins. St Andrews Degree
22	Tu	Education Board meets, 2.30 P.M.
23	W	
24	Th	
25	F	
26	S	
27	S	
28	M	London B.A. and M.B. Examinations begin.
29	Tu	
30	W	
31	Th	

OCTOBER—1889.

1 Tu
2 W
3 Th
4 F
5 S
6 S

7 M
8 Tu
9 W
10 Th
11 F
12 S
13 S

14 M
15 Tu
16 W
17 Th
18 F
19 S
20 S

21 M
22 Tu
23 W
24 Th
25 F
26 S
27 S

28 M
29 Tu
30 W
31 Th

NOVEMBER—1889.		
1	F	
2	S	
3	S	
4	M	
5	Tu	Education Board meets, 2.30 P.M.
6	W	
7	Th	
8	F	
9	S	
10	S	
11	M	
12	Tu	
13	W	Council meets.
14	Th	
15	F	
16	S	London B.A. and B.Sc. Pass Lists published.
17	S	[University, begin.
18	M	Examinations for B.A. and B.Sc. Honours, London
19	Tu	Education Board meets, 2.30 P.M.
20	W	Professor Frankland elected, 1888.
21	Th	Professors Steggall, Carnelley, Ewing, and Gilray
22	F	[elected, 1882.
23	S	
24	S	
25	M	John Wm. Maule Ramsay, Earl of Dalhousie, died 1887.
26	Tu	
27	W	
28	Th	University of London founded 1836.
29	F	
30	S	

NOVEMBER—1889.

1 F
2 S
3 S

4 M
5 Tu
6 W
7 Th
8 F
9 S
10 S

11 M
12 Tu
13 W
14 Th
15 F
16 S
17 S

18 M
19 Tu
20 W
21 Th
22 F
23 S
24 S

25 M
26 Tu
27 W
28 Th
29 F
30 S

DECEMBER—1889.

1	S	
2	M	
3	Tu	Education Board meets, 2.30 P.M.
4	W	
5	Th	
6	F	
7	S	
8	S	
9	M	
10	Tu	
11	W	Council meets.
12	Th	Examinations begin.
13	F	
14	S	First Term ends.
15	S	
16	M	
17	Tu	
18	W	
19	Th	Miss Baxter died, 1884.
20	F	
21	S	[nounced, 1880. Professor D'Arcy Thompson [appointed, 1884.
22	S	Miss Baxter's Original Subscription of £120,000 an-
23	M	Last day for sending in Certificates for London January
24	Tu	[Matriculation.
25	W	Christmas Day.
26	Th	
27	F	
28	S	
29	S	
30	M	
31	Tu	

DECEMBER—1889.

1	℟
2	M
3	Tu
4	W
5	Th
6	F
7	S
8	℟
9	M
10	Tu
11	W
12	Th
13	F
14	S
15	℟
16	M
17	Tu
18	W
19	Th
20	F
21	S
22	℟
23	M
24	Tu
25	W
26	Th
27	F
28	S
29	℟
30	M
31	Tu

JANUARY—1890.		
1	W	
2	Th	
3	F	
4	S	Entrance Exam. for Students under 16, at 10 A.M.
5	S	
6	M	Second Term begins.
7	Tu	Education Board meets, 2.30 P.M.
8	W	Council meets.
9	Th	
10	F	
11	S	
12	S	
13	M	London Matriculation Examination begins.
14	Tu	
15	W	
16	Th	
17	F	
18	S	
19	S	
20	M	
21	Tu	Education Board meets, 2.30 P.M.
22	W	
23	Th	
24	F	
25	S	
26	S	
27	M	
28	Tu	
29	W	
30	Th	
31	F	

JANUARY—1890.

1 W
2 Th
3 F
4 S
5 S

6 M
7 Tu
8 W
9 Th
10 F
11 S
12 S

13 M
14 Tu
15 W
16 Th
17 F
18 S
19 S

20 M
21 Tu
22 W
23 Th
24 F
25 S
26 S

27 M
28 Tu
29 W
30 Th
31 F

FEBRUARY—1890.

1	S	Last Day for Entry for London D.Sc. Examination.
2	S	
3	M	
4	Tu	Education Board meets, 2.30 P.M.
5	W	
6	Th	
7	F	
8	S	
9	S	
10	M	
11	Tu	
12	W	Council meets.
13	Th	
14	F	
15	S	Candidates for Preliminary Examinations at St Andrews
16	S	[give in names by this day.
17	M	
18	Tu	Education Board meets, 2.30 P.M.
19	W	London Matriculation Pass List published.
20	Th	
21	F	
22	S	
23	S	
24	M	
25	Tu	
26	W	
27	Th	St Andrews University founded 1411.
28	F	

FEBRUARY—1890.

1 S
2 S

3 M
4 Tu
5 W
6 Th
7 F
8 S
9 S

10 M
11 Tu
12 W
13 Th
14 F
15 S
16 S

17 M
18 Tu
19 W
20 Th
21 F
22 S
23 S

24 M
25 Tu
26 W
27 Th
28 F

MARCH—1890.		
1	S	
2	S	
3	M	
4	Tu	Education Board meets, 2.30 P.M.
5	W	
6	Th	
7	F	
8	S	
9	S	
10	M	Class Examinations begin.
11	Tu	
12	W	Council meets. Preliminary Examinations begin at St
13	Th	[Andrews.
14	F	
15	S	Second Term ends.
16	S	
17	M	
18	Tu	
19	W	
20	Th	
21	F	
22	S	
23	S	
24	M	
25	Tu	
26	W	
27	Th	
28	F	
29	S	
30	S	
31	M	

MARCH—1890.

1 S
2 ℌ

3 M
4 Tu
5 W
6 Th
7 F
8 S
9 ℌ

10 M
11 Tu
12 W
13 Th
14 F
15 S
16 ℌ

17 M
18 Tu
19 W
20 Th
21 F
22 S
23 ℌ

24 M
25 Tu
26 W
27 Th
28 F
29 S
30 ℌ

31 M

APRIL—1890.

1	Tu	
2	W	
3	Th	
4	F	Good Friday.
5	S	
6	S	
7	M	
8	Tu	
9	W	Council meets.
10	Th	
11	F	
12	S	
13	S	
14	M	Third Term begins.
15	Tu	Education Board meets, 2.30 P.M.
16	W	
17	Th	
18	F	
19	S	
20	S	
21	M	
22	Tu	
23	W	
24	Th	
25	F	
26	S	
27	S	
28	M	
29	Tu	Education Board meets, 2.30 P.M.
30	W	

APRIL—1890.

1 Tu
2 W
3 Th
4 F
5 S
6 S

7 M
8 Tu
9 W
10 Th
11 F
12 S
13 S

14 M
15 Tu
16 W
17 Th
18 F
19 S
20 S

21 M
22 Tu
23 W
24 Th
25 F
26 S
27 S

28 M
29 Tu
30 W

MAY—1890.

1	Th	
2	F	
3	S	
4	S	
5	M	
6	Tu	
7	W	
8	Th	
9	F	
10	S	
11	S	
12	M	
13	Tu	Education Board meets, 2.30 P.M.
14	W	Council meets.
15	Th	
16	F	
17	S	
18	S	
19	M	
20	Tu	
21	W	
22	Th	
23	F	
24	S	Queen Victoria born, 1819.
25	S	
26	M	
27	Tu	Education Board meets, 2.30 P.M.
28	W	
29	Th	
30	F	
31	S	

MAY—1890.

1 Th
2 F
3 S
4 ✠

5 M
6 Tu
7 W
8 Th
9 F
10 S
11 ✠

12 M
13 Tu
14 W
15 Th
16 F
17 S
18 ✠

19 M
20 Tu
21 W
22 Th
23 F
24 S
25 ✠

26 M
27 Tu
28 W
29 Th
30 F
31 S

JUNE—1890.

1	S	
2	M	Outstanding College Accounts ought to be rendered to
3	Tu	Treasurers on or before 14th.
4	W	
5	Th	
6	F	
7	S	
8	S	
9	M	
10	Tu	Education Board meets, 2.30 P.M.
11	W	Council meets.
12	Th	
13	F	
14	S	
15	S	
16	M	
17	Tu	
18	W	
19	Th	
20	F	
21	S	Lectures end.
22	S	
23	M	Class Examinations begin.
24	Tu	Education Board meets, 2.30 P.M.
25	W	
26	Th	College Library Closed for Inspection. All Books to
27	F	Education Board meets, 2.30 P.M. [be returned.
28	S	
29	S	
30	M	Education Board meets: Distribution of Prizes and
		[Certificates. Close of Session.

JUNE—1890.

1 S

2 M
3 Tu
4 W
5 Th
6 F
7 S
8 S

9 M
10 Tu
11 W
12 Th
13 F
14 S
15 S

16 M
17 Tu
18 W
19 Th
20 F
21 S
22 S

23 M
24 Tu
25 W
26 Th
27 F
28 S
29 S

30 M

JULY—1890.

1	Tu	College Library reopens.
2	W	
3	Th	
4	F	
5	S	
6	S	
7	M	
8	Tu	David Small died 1885.
9	W	Council meets.
10	Th	
11	F	
12	S	
13	S	
14	M	
15	Tu	
16	W	
17	Th	
18	F	
19	S	
20	S	
21	M	
22	Tu	
23	W	
24	Th	
25	F	
26	S	
27	S	
28	M	
29	Tu	
30	W	
31	Th	

JULY—1890.

1 Tu
2 W
3 Th
4 F
5 S
6 S

7 M
8 Tu
9 W
10 Th
11 F
12 S
13 S

14 M
15 Tu
16 W
17 Th
18 F
19 S
20 S

21 M
22 Tu
23 W
24 Th
25 F
26 S
27 S

28 M
29 Tu
30 W
31 Th

AUGUST—1890.

1	F	College Library closed during this month.
2	S	
3	S	
4	M	Dr Boyd Baxter died, 1882.
5	Tu	
6	W	
7	Th	
8	F	
9	S	
10	S	
11	M	
12	Tu	
13	W	Council meets.
14	Th	
15	F	
16	S	
17	S	Professor Patrick Geddes appointed, 1888.
18	M	
19	Tu	
20	W	
21	Th	Principal Peterson elected, 1882.
22	F	
23	S	
24	S	
25	M	
26	Tu	
27	W	
28	Th	
29	F	
30	S	
31	S	

AUGUST—1890.

1 F
2 S
3 S

4 M
5 Tu
6 W
7 Th
8 F
9 S
10 S

11 M
12 Tu
13 W
14 Th
15 F
16 S
17 S

18 M
19 Tu
20 W
21 Th
22 F
23 S
24 S

25 M
26 Tu
27 W
28 Th
29 F
30 S
31 S

Trustees

WILLIAM HUNTER, Lord Provost of Dundee.

JOHN SHIRESS WILL, Esq., Q.C., M.P.

EDMUND ROBERTSON, Esq., LL.D., M.P.

J. F. B. FIRTH, Esq., LL.B., M.P.

JOHN CAMPBELL SMITH, Esq., LL.D., Sheriff-Substitute for Forfarshire, Dundee.

HENRY M'GRADY, Lord Dean of Guild, Dundee.

Governors

The Governors of the College are the supreme Governing Body.

(1.) All Donors of £50 and upwards, *for life;* and all Annual Subscribers of £5 and upwards, *during subscription.*

G. W. Baxter, Esq.	(Life Governor).
E. F. Maitland, Esq.	Do.
James Smart, Esq.	Do.
George Armitstead, Esq.	Do.
George H. MacT. Thoms, Esq. of Aberlemno, F.R.S.E., F.S.A.Scot.	Do.
T. W. Thoms, Esq.	Do.
James Martin White, Esq. of Balruddery	Do.
Victor Fraenkl, Esq.	Do.
Robert B. Don, Esq., M.A.	Do.
The Rt. Hon. The Earl of Camperdown	Do.
William Ogilvy Dalgleish, Esq. of Errol	Do.
Thomas Thornton, Esq.	Do.
John Robertson, Esq.	Do.
Sir Andrew Clark, Bart., M.D., LL.D., F.R.S.	Do.
William J. Small, Esq., M.A.	Do.
I. J. Weinberg, Esq.	Do.
John Bett, Esq.	Do.
John Sharp, Esq. of Balmuir	Do.
William C. Leng, Esq.	Do.
Thomas Hunter Cox, Esq. of Maulesden	Do.
James G. F. Lowson, Esq., Ph.D.	Do.
James F. Low, Esq.	Do.
James Smieton, Esq., M.A., B.Sc.	Do.

J. More Smieton, Esq.	(Life Governor).
Hugh Ballingall, Esq.	Do.
A. Sidney White, Esq.	Do.
Mrs M. H. Ogilvie	Do.
Mrs Eleanor Sharp	Do.
Mrs E. W. Wenley	Do.
Miss Beatrice White	Do.
Miss Alice White	Do.
Miss Winifred White	Do.
William Carnelley, Esq.	Do.
Professor Carnelley, Aberdeen,	Do.
James G. Orchar, Esq.,	Do.
Principal Peterson,	Do.
Professor D'Arcy W. Thompson	(Subscriber).

(2.) Representatives of Corporate Bodies or Associations contributing a Donation of £250 or upwards, *in perpetuity;* or of such Bodies or Associations subscribing £10 per annum, *during subscription*

The Edinburgh Angus Club—John Shiell, Esq., Solicitor, Dundee, Representative.

(3.) The following Official and Representative persons :—

(1.) The Right Honourable the Earl of Strathmore and Kinghorne, Lord Lieutenant of the County of Forfar,

(2.) Sir John Ogilvy of Inverquharity, Baronet, Convener of the County of Forfar,

(3.) James William Barclay, Esq., Member of Parliament for the County of Forfar,

(4.) John Shiress Will, Esq., Q.C., Member of Parliament for the Montrose District of Burghs,

(5.) John Comrie Thomson, Esq., Advocate, Sheriff of the County of Forfar,

(6.) Henry M'Grady, Lord Dean of Guild of the City of Dundee,

And the successors of the persons above named in their said respective offices of Lord Lieutenant and Convener of the County of Forfar, Members of Parliament for the County of Forfar, and the Montrose District of Burghs, Sheriff of the County of Forfar, and Dean of Guild of the City of Dundee.

(7.) A representative appointed by each of the following bodies, viz.:—For the Dundee Chamber of Commerce—H. B. Fergusson, Esq.; for the School Board of the Burgh of Dundee—Rev. Peter Grant, D.D.; for the Directors of the Dundee High School—Alexander Henderson, Esq.

(8.) A representative appointed by the Committee of Management of the Dundee Free Library —Rev. Colin Campbell, B.D.

(9.) The Members of the Council for the time being

The Council

The Council is the Managing Body of the College, and is responsible to the Governors for the proper discharge of its functions.

(1.) Elected by the Governors—Nine Members, of whom three retire annually, and are eligible for re-election.

*WILLIAM BROWNLEE, Esq.
*G. W. BAXTER, Esq.
*R. B. DON, Esq., M.A.
Rev. W. J. COX.
JOHN ROBERTSON, Esq.
JAMES G. ORCHAR, Esq.
J. MARTIN WHITE, Esq.
ROBERT SINCLAIR, Esq., M.D.
JAMES SMIETON, Esq., M.A., B.Sc.

(2.) Members *ex officio* :—

Lord Provost HUNTER.
EDMUND ROBERTSON, Esq., LL.D., M.P.
J. F. B. FIRTH, Esq., LL.B., M.P.
Sheriff CAMPBELL SMITH, LL.D., Dundee.

(3.) Elected by the Owens College, Manchester :—

Sir HENRY ENFIELD ROSCOE, LL.D., F.R.S., M.P.

(4.) Elected by the Lord President of the Privy Council :—

JAMES DONALDSON, Esq., LL.D., Principal of United College of Saint Salvator and Saint Leonard, St Andrews.

(5.) Elected by the Principal and Professors of the College :—

JAMES CUNNINGHAM, Jun., Esq., M.A.

(6.) The President of the College, if any.

*Retire in October 1889.

The Education Board

The Education Board organises and directs the Education of the College, and is responsible to the Council for the proper discharge of its functions.

Chairman—

Principal W. PETERSON, M.A., LL.D.

Professor J. E. A. STEGGALL, M.A.

Professor J. A. EWING, B.Sc., F.R.S., F.R.S.E.

Professor THOMAS GILRAY, M.A., F.R.S.E.

Professor D'ARCY W. THOMPSON, B.A.

Professor PATRICK GEDDES, F.R.S.E.

Professor A. MELVILLE PATERSON, M.D., *Hon. Sec.*

Professor PERCY F. FRANKLAND, Ph.D., B.Sc.

Professors, Lecturers, and other Officers of the College

Principal:

W. PETERSON, M.A. Edin. and Oxon., LL.D. St Andrews.

Mathematics and Natural Philosophy,	Professor J. E. A. STEGGALL, M.A. Trinity College, Cambridge; *Assistant Lecturer and Demonstrator in the Physical Laboratory*— JOHN M'COWAN, M.A., B.Sc.
Chemistry, - -	Professor PERCY F. FRANKLAND, Ph.D., B.Sc., London; Assoc. Roy. School of Mines; F.I.C. *Assistant Lecturer and Demonstrator in the Chemical Laboratory*— ANDREW THOMSON, M.A., D.Sc.
Engineering and Drawing, - -	Professor J. A. EWING, B.Sc., F.R.S., F.R.S.E. *Assistant and Lecturer on Drawing*— THOMAS REID.
Biology (JOHN BOYD BAXTER Chair),	Professor D'ARCY W. THOMPSON, B.A. Trinity College, Cambridge.
Botany (J. F. WHITE Chair), - -	Professor PATRICK GEDDES, F.R.S.E.
Anatomy (T. H. Cox Chair), - -	Prof. A. MELVILLE PATERSON, M.D.
Operative Surgery,	*Lecturer*—Dr MACEWAN.
Classics and Ancient History, - -	The PRINCIPAL. *Assistant Lecturer and Lecturer in Logic*— GILBERT ELLIOT, B.A., late Scholar of Lincoln College, Oxford.
English Language and Literature and Modern History,	Professor THOMAS GILRAY, M.A., F.R.S.E.
Logic, - - -	*Lecturer*—Mr ELLIOT.
French and German,	*Lecturer*—M. H. DURLAC.
Fine Art, - -	*Teacher*—Miss JACK.
Secretaries, -	Messrs SHIELL & SMALL, Solicitors.

Chemical Laboratory Steward, - -	JOHN FOGGIE.
Mechanic, - - -	JOHN MACDONALD.
Smith and Fireman,	
Library Attendant, -	DAVID MILLAR.
Laboratory Attendants,	WILLIAM ABBOTT, ALEXANDER RODGER, PETER DUNCAN.
Janitor, - - -	ALEXANDER MARTIN.

College Regulations

(1.) No Student will be admitted to the Day Classes under the age of fifteen.

(2.) Students under sixteen seeking admission as Day Students will be required to pass an Entrance Examination in English Grammar and Composition, Arithmetic, and either (*a*) Elementary Latin, or (*b*) Elementary Mathematics or (*c*) some branch of Science to be chosen by the Candidate. Candidates who desire to be admitted to this Examination must give at least three days' notice, specifying the Subjects in which they wish to be examined.

The Examination will be held this year on Saturday, 5th October, from 10 to 12 and 1 to 2; also on Saturday, 4th January 1890, during the same hours.

(3.) All departments are open to both sexes on the same terms.

(4.) The Principal will attend at the College for the purpose of admitting Students, at the beginning of each term.

Students should enrol themselves on Friday, 4th October, from 7 to 9 P.M., or on Saturday 5th, from 11 A.M. to 2 P.M., or from 7 to 9 P.M. Those who have been unable to enter on the appointed days will be admitted by the Principal at times which will be afterwards announced.

(5.) Every candidate for admission may be required to produce a testimonial of good character.

(6.) A card of admission to the several Classes will be issued by the Secretaries, on presentation of a signed form obtained from the Principal, and on payment of the Fees.

No Student will be entitled to attend the Classes until he shall have complied with this regulation.

(7.) All cards must be presented to the Professor before the Student's name can be placed on the class list.

(8.) Students are admitted for the whole Academic Year, but in exceptional circumstances they may enter at the beginning of the Second or Third Term.

(9.) All Students on admission must sign an undertaking to observe the Statutes and Regulations of the College for the time being.

(10.) In addition to Class Fees, Day Students will be required to pay on entering the College a Registration Fee of 10s. 6d. each. Those Day Students, however, who desire to attend one or two courses of lectures only, may pay in lieu of this fee a sessional fee of 3s. 6d. for each Class attended.

(11.) No Registration Fee is payable in respect of the Evening Classes.

(12.) Smoking within the precincts of the College is strictly forbidden.

The Professors will be glad at any time to give advice and information about all departments of the College work. They will be at the College for this special purpose during the hours of Registration, on Friday, 4th October, from 7 to 9 P.M., and Saturday 5th, from 11 A.M. to 2 P.M., and from 7 to 9 Evening. Students are strongly recommended to take this opportunity of consulting the Professors as to the course of study best suited to their individual wants.

PRIZES AND CERTIFICATES.

Prizes, and Certificates of Merit of the First and Second Class, will be awarded in each subject at the close of the Academic Year, on the combined results of the Examinations and general Class Work. Those Day Students who gain five First-Class Certificates of Merit (in the same year or in different years) will be entitled to a Certificate of Honour. Certificates will not, however, be counted separately unless gained in at least three of the following departments:—(1) Mathematics, (2) Natural Philosophy, (3) Chemistry, (4) Engineering, (5) Biology, (6) English, (7) History, Ancient or Modern, (8) Latin, (9) Greek, (10) Modern Languages, (11) Botany, (12) Anatomy. Very exceptional merit in the *highest* branch of any subject will also entitle to a Certificate of Honour, even though five ordinary Certificates have not been previously gained.

Certificates of Attendance will also be granted, provided the Lectures have been attended with sufficient regularity. When a Student has been absent, it is expected that he will report the cause of his absence to the Professor on his return to the Class. In case of absence extending over more than five Meetings of the Class, a written explanation should be sent, in default of which the name may be expunged from the roll.

Library Regulations

1. The Library shall be open for Reference during Term to all Day and Evening Students, from 10 A.M. to 1 P.M., and from 2 to 4 P.M. During the Winter Session it will be open also from 7 to 9.15 P.M.

2. Day Students, and other persons who may receive special permission from the Principal, shall have the further privilege of borrowing not more than two volumes at a time (except in special cases), for a period not exceeding a fortnight. If, however, no application has meanwhile been made, the volume or volumes may be re-borrowed for successive periods of two weeks. Breaches of this regulation may lead to the imposition of a fine.

3. No book borrowed under Rule 2 shall be removed from the Library until it has been duly entered on one of the forms provided for the purpose, which shall be filled up by the Student, and given to the Attendant.

4. Students are permitted to take books from the shelves, but they are to be returned to the Attendant, and not to be placed in the shelves by the readers.

5. The above Rules shall not apply to volumes specially kept in the Library *for reference only.*

6. Strict silence must be observed in the Library.

7. The Library will be closed during the last week of June, when all books previously borrowed must be returned for inspection. It will also be entirely closed during August.

8. In the event of a book being injured, the person who has injured it will be required to supply another copy in its place, or make good the loss to the satisfaction of the Education Board.

The following Periodicals are placed on the Table in the Library —

*Nature.
*Proceedings of the Royal Society of London.
*Philosophical Transactions of the Royal Society of London.
Proceedings of the Royal Society of Edinburgh.
Philosophical Magazine.
Journal of the Society of Arts.
Proceedings of the Cambridge Philosophical Society.
*Report of the British Association.
*Transactions of the Royal Scottish Society of Arts.
*Comptes Rendus.
Quarterly Journal of Mathematics.
The Electrician.
*Wiedemann's Annalen der Physik und Chemie.
*Beiblätter zu den Wiedemann's Annalen der Physik und Chemie.
*Journal of the Chemical Society of London.
*Journal of the Society of Chemical Industry.
*Chemical News.
Pharmaceutical Journal and Transactions.
*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.
Liebig's Annalen der Chemie.
*Minutes of Proceedings of the Institution of Civil Engineers.
*Proceedings of the Institution of Mechanical Engineers.
The Engineer.
Engineering.
*Fauna and Flora des Golfes von Neapel.
Morphologisches Jahrbuch.
Zeitschrift f. wissenschaftliche Zoologie.
Quarterly Journal of Microscopical Science.
Journal of Royal Microscopical Society.
Archives de Biologie.
Archives de Zoologie, Expérimentale et Générale.
Arbeiten aus der Zoologischen Institut des Univ. Wien.
*Botanisches Centralblatt.
*Biologisches Centralblatt.
*Zoologischer Anzeiger.
*Anatomischer Anzeiger.
Archiv f. Mikroskopische Anatomie.
*Annales du Musée de Marseille.
American Naturalist.
*Journal of the Linnæan Society (Zoology and Botany).
Jenaische Zeitschrift.
*Mittheilungen a. d. Zool. Station zu Neapel.
*Studies from the Biological Laboratory of the Johns Hopkins [University.
*Journal of Hellenic Studies.
*Journal of Philology.
The Athenæum.
*Journal of Education.
Educational Times.
*Classical Review.
British Medical Journal.
Lancet.
Journal of Anatomy and Physiology.
Archiv für Anatomie und Entwicklungsgeschichte.

* Sets of these Periodicals will be found in the Library, as well as the current numbers.

Armitstead Scholarships

A. ENTRANCE SCHOLARSHIPS.

These Scholarships, founded and endowed in 1883 by GEORGE ARMITSTEAD, Esq., M.P., are awarded under the following Regulations, which the Council reserves power to alter from time to time as occasion may require.

1. Two Entrance Scholarships of from £20 to £25 each, according to the return from the Endowment, and tenable for one year, will be awarded annually, in the beginning of October.

2. Competition will be open to all persons, of either sex, who have not been Day Students of the College.

3. Notice of intention to compete, with the name of the School from which the Candidate comes, must be sent to the Principal on or before the 30th September in each year.

4. The Subjects of Examination will be as under:—

MATHEMATICS: { Arithmetic; Algebra, up to Progressions; Euclid—Books I.—III., and Book VI.

LATIN: Translation, Composition, and General Paper.

GREEK, or FRENCH, or GERMAN.*

ENGLISH: { History of the English Language (Morris's Historical English Grammar recommended); Composition (an Essay on a given subject); Questions in English History and Literature.

In estimating the value of the papers sent in, due weight will be given to special eminence in a particular department.

* The Candidate must intimate, in sending in his or her name, which of these languages is selected for examination.

5. The successful Candidates must enter the College as Day Students, and will be required to follow out some line of study, to be determined after consultation with the Professors. A certain minimum of attendance on the College Classes will be required, either in the department of Arts or of Science; or the holders of the Scholarships may follow, in the first instance, such a mixed course as that prescribed for the London University Matriculation Examination.

6. The Council reserves the right of withholding either or both of the Scholarships, in the event of the Examiners reporting that no Candidate of sufficient merit has come forward.

7. The Examination will commence on WEDNESDAY, the 2nd October, at 9 A.M.

1884	*William A. Taylor.* *Maggie K. Wilson.*	1885	*Bella D. Martin.* *Agnes B. Pirie.*
1886	*Thomas S. Murray.* *Aimée B. Cox.*	*1887	*M. L. Pattullo.* *Henry C. Williamson.*

* Prize of Ten Pounds—*Fred. Shepherd.*

1888 *J. R. Dick.*

B. SECOND YEAR'S SCHOLARSHIPS.

1. Two Scholarships of from £20 to £25 each, according to the return from the Endowment, and tenable for one year, will be awarded annually, in the beginning of October.

2. These Scholarships will be open to all Day Students entering upon their Second Year. Candidates must have attended not less than two regular Courses at the College during the year immediately preceding the competition.

3. Notice of intention to compete must be sent to the Principal on or before the 30th September in each year

4. One Scholarship will be given in Arts, and the other in Science.

(a.) Candidates for the ARTS SCHOLARSHIP will be examined in MATHEMATICS, CLASSICS, and ENGLISH.

In MATHEMATICS the subjects of examination will be the same as those prescribed for the Entrance Scholarships, but the standard required will be higher.

The examination in CLASSICS will include Latin and Greek Composition, and a General Paper. The following books are prescribed:—CICERO, Pro Cluentio; HOMER, Odyssey, Book I.; PLATO, Apology.

Selected editions of these works will be found among the Books of Reference in the Library.

The ENGLISH subjects will be—(1) The History of the English Language (Morris's Outlines of English Accidence recommended); (2) Composition (an Essay on a given subject); and (3) English Literature and History, from 1485 to 1688. Books recommended:—J. F. BRIGHT'S History of England, Personal Monarchy, 1485–1688, and CRAIK'S Manual of English Literature, or MORLEY'S First Sketch.

(b.) Candidates for the SCIENCE SCHOLARSHIP will be examined in—

MATHEMATICS (as above); and further in *two* of the following, one of which must be Chemistry or Physics:—

HIGHER MATHEMATICS, including Mechanics.

CHEMISTRY (non-metallic elements), including general qualitative analysis.

PHYSICS.
ENGINEERING.
NATURAL HISTORY.
BOTANY.
ANATOMY.

5. The successful Candidates must be Day Students of the College during the tenure of their Scholarships, and will be required to follow out some line of study to be determined after consultation with the Professors. A certain minimum of attendance on Lectures and in the Laboratories will be insisted on, and the holders of the Scholarships may be required to read for the Degree Examinations of St Andrews University or of the University of London.

6. The Council reserves the right of withholding either or both of the Scholarships, in the event of the Examiners reporting that no Candidate of sufficient merit has come forward. A Scholarship thus declared vacant may be conferred on the Candidate who stands next in order of merit to the successful competitors for the Two Entrance Scholarships.

7. The Examination will commence on WEDNESDAY, the 2nd October, at 9 A.M.

1884	Arts Scholarship— *Alexander Robertson*, *William Gracie*, } Equal. Science Scholarship—*John Y. Gray.*	
1885	Arts Scholarship—Not awarded. Science Scholarship—*G. D. Crawford.*	
1886	Arts Scholarship— *Agnes B. Pirie.* Science Scholarship—*Not awarded. Prize of Ten Pounds—*T. M. Wilson.*	
1887	Science Scholarship—*Thomas S. Murray.*	
1888	Science Scholarship—*John S. Lumsden.*	

* The unawarded balance was offered as a Special Prize at the end of the Session and was divided between W. Frew and T. M. Wilson.

Smart Bursary in Engineering

This Bursary was founded in March 1883, by JAMES SMART, Esq., of Brechin. It consists of the free proceeds of the sum of five hundred pounds, and is tenable for one year.

The Council has made the following Regulations for the Bursary:—

(1.) No Candidate will be admitted to compete who has been a Day Student of the College for more than one year; and none will be eligible for the Bursary whose age on the 1st October next preceding the examination shall be less than 16, or more than 25.

(2.) Notice of intention to compete must be sent to the Principal, on or before 30th September in each year.

(3.) Candidates will be examined in Arithmetic, Algebra, Geometry, Trigonometry, the Elements of Natural Philosophy, and Geometrical and Mechanical Drawing.

(4.) The Examination will be held in the beginning of October in each year.

(5.) The successful candidate will be required to attend the Engineering Classes, and a Class in Mathematics, with a further choice of

(*a*) A Lecture Course in Natural Philosophy, and at least six hours a week Practical Physics; or,

(*b*) A Lecture Course in Chemistry, and at least six hours a week Practical Chemistry.

(6.) The Council reserves the right of withholding the Bursary for any year, if, in the opinion of the Examiners no candidate of sufficient merit present himself. The conditions of Examination are also liable to revision.

The Examination will commence on THURSDAY, the 3rd October, at 9 A.M.

1883.—*J. T. Ewen.*
1884.—*G. Powrie.*
1885.—*David Low.*
1886.—*H. Japp.*
1887.—*R. H. Adamson.*
1888.—*A. Keiller Maxwell.*

Graduation in Arts and Science

The classes in Arts and in Science are intended, generally, to be used by Students as a means of preparation for graduation at some University: special attention is directed to the requirements of the following Universities:—

LONDON | ST ANDREWS | EDINBURGH

The degrees of LONDON UNIVERSITY are obtained by examination alone, no conditions either of class attendance or of academic residence existing.

The general nature of the examinations is as follows:— Students having attained the age of sixteen may present themselves for matriculation at one or other of the centres at which this examination is conducted—Edinburgh and Glasgow being two of these. The subjects include English, Latin, Mathematics, Science, and Modern Languages, but a certain amount of choice is allowed within these groups, and recently the examination has been much simplified.

After this examination has been passed a Student has an intermediate and a final examination, both in Arts and Science. On passing successively these two examinations in either department, the Degree of B.A. or B.Sc. is attained. Fuller information as to the subjects of these examinations will be found, together with details about higher degrees, on page 218 *et seq.*

In University College there are courses enough to afford Students means of preparing for the complete Matriculation Examinations, those for the B.Sc. degree and, with the exception of Mental and Moral Science, those for the B.A. degree also.

The degree of B.Sc. in the UNIVERSITY OF ST ANDREWS is attainable by Students of University College, Dundee, who attend only the prescribed classes in the College. These classes and the general regulations affecting such Students will be found stated in detail on page 227. The general nature of the course prescribed is as follows :—Students matriculate in each of these years by paying a fee and inscribing their names in the Matriculation Album at St Andrews. They must then present themselves (or submit a recognised certificate of exemption) for a preliminary examination in English, Latin, Mathematics, and Mechanics, and two optional subjects from eleven that are specified.

The first examination follows, and may be taken in portions, at least two of the following subjects at a time :—Mathematics, Natural Philosophy, and five others (see page 227) chosen by the Student. Of these five, two must be treated by Laboratory methods. In each of the seven subjects a proper course must have been taken and a certificate obtained to that effect. For the next and final examination two subjects out of five must be professed. Of these, one at least must be treated practically.

The conditions of attendance are, that three whole years must have been spent in study within University College, Dundee, and each of these years must be constituted by at least 150 hours' attendance in at least two classes of at least 50 lectures each.

A course of three years is required to qualify for the degrees in Science of EDINBURGH UNIVERSITY. Of these three years, Students are permitted to take two in University College, Dundee, attending during them the requisite classes. For further information see p. 238.

The attention of Women Students is directed to the Regulations of the University of Oxford Examinations open

to Women, without residence (see p. 246), and also to the various departments (Pass and Honours) of the Examinations for the L.L.A. Certificate at St Andrews.

The various courses are also suitable for candidates preparing for the Home Civil Service (Higher Division), and the Indian Civil Service. For further information, see p. 247.

Graduation in Medicine

UNIVERSITY OF EDINBURGH.—The University Court recognises for Graduation in Medicine the Courses of Lectures and Practical Classes in Chemistry, Natural History, Botany, and Anatomy. The first year of Medical study can thus be completely overtaken at University College.

In accordance with the Statutes of all the Scottish Universities, another *Annus Medicus* can be taken in Dundee by means of attendance during the Winter Session on Practical Anatomy and on the Medical and Surgical Practice of the Royal Infirmary.

For further information, see pp. 139—151.

UNIVERSITY OF LONDON.—Students preparing for the Medical degrees of this University can obtain full instruction in the subjects of the Preliminary Scientific Examination. They are recommended to devote their first year of study entirely to these subjects.

For further information, see p. 224.

The City and Guilds of London Institute

THE CITY AND GUILDS OF LONDON Institute for the Advancement of Technical Education has included University College in the list of Colleges the Professors of which are entitled to grant Certificates that will be accepted in lieu of those of the Science and Art Department from candidates for the Institute's full Technological Certificate.

Government Aid towards the Instruction of Science Teachers

In accordance with a minute adopted by the Right Honourable the Lords of the Committee of Her Majesty's Most Honourable Privy Council on Education, June 25, 1886 (Science Form, No. 1193), their Lordships are prepared to pay three-fourths of the fees for courses of Laboratory instruction in the Physical and Chemical Laboratories, and for courses in Mathematics and Mechanics, Physics, Chemistry, and Biology, as stated below, for a limited number of Teachers engaged in Science Teaching, on condition that satisfactory terminal reports of their progress (to be ascertained by examination), and of their conduct, be received at the end of the Winter, Spring, and Summer Terms.

Applications for this privilege have to be made to the Secretary to the Science and Art Department, South Kensington.

The selection of the applicants rests with the Science and Art Department.

The fees for twelve hours a week for the Session, from October to June, are:—

For the Chemical Laboratory, including one set of Apparatus,	£8	8	0
For the Physical Laboratory,	6	6	0
For course in Mathematics, of 60 Lectures,	1	11	6
or, including 60 Tutorial Hours,	2	2	0
For Physics, of 60 Lectures,	1	11	6
For Mechanics, of 60 Lectures,	1	11	6
For Chemistry, of 90 Lectures,	2	2	0
For Biology, of 90 Lectures, and Laboratory Instruction,	3	3	0

NOTE.—One-fourth of the fee for the whole Session must be paid by the Student on entrance, under the usual conditions of the College. The remaining three-fourths of the fee will be paid by the Department, in equal instalments, at the commencement of each term, subject, however, to the right of the Department to withhold payment of the second and third instalments should the reports not be satisfactory. The above fees for the Chemical Laboratory include also a portion of the apparatus.

Patrick A. Lowson Memorial Scholarship

This Scholarship of not less than £60 per annum is tenable for two years at any University in the United Kingdom, or at University College, Dundee. Candidates, who must have attended some School in Dundee or Broughty Ferry for three years, may learn the conditions on which the Scholarship is held by applying to William Lowson, Esq., 107 Murraygate, Dundee, with whom applications must be lodged on or before 1st September in the year in which a vacancy occurs. The Scholarship shall not be open for competition to young men who, at the date appointed for lodging of applications, shall have been in attendance at a University, or the University College, Dundee, for a longer period than One Session. The next competition will be held in October. Candidates will be examined in Geometry, including the Elements of Trigonometry, and Algebra, and in two or more of the following subjects, chosen by the candidates themselves, viz.:—British History and Literature, Latin, Greek, French, German.

Syllabus

OF THE

DAY CLASSES.

The Academic Year is divided as follows:—

1. *Winter Session*—
   (*a*) First Term—
   Beginning Saturday, 5th October, 1889.
   Ending Saturday, 14th December, 1889.
   (*b*) Second Term—
   Beginning Monday, 6th January, 1890.
   Ending Saturday, 15th March, 1890.
2. *Summer Session, or Third Term*—
   Beginning Monday, 14th April, 1890.
   Ending Monday, 30th June, 1890.

The Evening Classes meet only during the Winter Session, with the exception of the Evening Class of Botany, which meets during the Summer Session, and also certain classes in the Chemical Department.

MATHEMATICS AND NATURAL PHILOSOPHY

PROFESSOR STEGGALL

Assistant Lecturer and Demonstrator in the Physical Laboratory, - } JOHN M'COWAN, M.A., B.Sc.

The Classes in Mathematics and Natural Philosophy are primarily arranged to meet the wants of the students who wish to prepare for the B.Sc. degree of the St Andrews University; they are also adapted, as far as possible, to the requirements of other examinations, such as those of the University of London.

Students who wish to go through a systematic course of instruction in Mathematics and Natural Philosophy are advised to take, if possible, the following work along with their other classes during successive years:—

First Year { Junior Mathematics and Tutorial Class, Mechanics, Physics;

TOTAL FEE—£5 5s. 0d.

Second Year { Intermediate Mathematics and Tutorial Class, Physics, third term, Physical Laboratory Elementary Course, 6 to 12 hours per week;

TOTAL FEE—£6 2s. 0d. to £9 5s. 0d., according to the amount of Laboratory work taken.

Third Year { Senior Mathematics, Mathematical Physics, Physical Laboratory Advanced Course, 6 to 12 hours per week;

TOTAL FEE—£5 5s. 0d, to £8 8s. 0d., according to the amount of Laboratory work taken.

Students who, while unable to take all the classes recommended, wish to systematise their studies, are recommended to consult the Professor, with a view to following a course modified so as to suit their other arrangements: students will, of course, arrange their studies in other departments so as to best fulfil their ultimate intentions.

MATHEMATICS

The following Courses of Lectures are offered on the portions of Mathematics most frequently studied:—

JUNIOR CLASS

Tuesday and Thursday, 9—10

Arithmetic.—Theory of pure Arithmetic, including numeration, notation, scales of notation, decimals, circulating decimals, factors, tests of divisibility, contracted methods of multiplication and division, evolution.

TEXT BOOK—Brook-Smith's *Arithmetic.*

Geometry.—Elementary conceptions and definitions, and the substance of Euclid, i. to iii., and vi., 1—19, 33. No attempt will be made to rehearse *every* proposition in class—this being left for home work—but a connected and complete course covering the above ground will be given. Besides this, problems to be done at home will be set at every lecture, and about a third of the lecture hour will be given to their consideration. It is assumed that at home the students will read during this course the propositions of Euclid's works noted above, in anticipation of their discussion at each succeeding lecture.

TEXT BOOK—Any modern edition of Euclid's *Elements*: that, for example, of Mackay, Nixon, or Langley and Phillips.

Algebra.—The elementary notions and simple rules will be treated, but problems in the mere elements of addition, &c., will not be set. The more important work of this course will consist of such things as the rule of signs, fractional multiplication, factors, common factors and multiples; equations, simple and quadratic; definition and illustration of terms such as coefficient, cyclical order, dimensions, symmetrical and homogeneous; identities, ratio, proportion, arithmetical progression.

TEXT BOOK—The *Elementary Algebra* of Hall and Knight, Hamblin Smith, or Charles Smith.

Trigonometry.—Measurement of angles; definition of sine, cosine, tangent, and other ratios; numerical values of the ratios of special angles; easy questions involving right angled triangles and the elementary work above.

TEXT BOOK—The *Elementary Trigonometry* of Walmsley or Lock.

FEE—£1 11s. 6d.

TUTORIAL CLASS

There will be a Tutorial Class on Mondays and Wednesdays, at 11, in which Students will receive direction and assistance in working problems and examples set in class. Attendance at this class is expected of junior students, and recommended to all others.

FEE—10s 6d.

Attendance in the Junior and the Tutorial Classes will qualify for a certificate of attendance in reference to the degree in Science of St Andrews University.

*** The various lectures will be independent of any particular Text Books, but those mentioned are suggested as likely to be useful to Students.

INTERMEDIATE CLASS

Monday, Wednesday, and Friday, 9—10 (during the Winter Session).

Geometry.—The work will be taken up at the point reached by the Junior Class, and, as far as possible, the following parts of the subject will be studied:—Elements of modern geometry and of solid geometry, elements of co-ordinate geometry applied to the straight line and circle.

TEXT BOOKS—Casey's *Sequel to Euclid;* Wilson's *Solid Geometry and Conic Sections;* Smith's *Conic Sections.*

Algebra.—Indices and surds, geometrical and harmonical progressions, permutations and combinations, binomial theorem, logarithms both in application and in theory, the nature of series, exponential series, approximations by means of series, the elements of the theory of equations.

TEXT BOOKS—Todhunter's *Algebra for Colleges and Schools;* C. Smith's *Treatise on Algebra;* Hall and Knight's *Higher Algebra;* Todhunter's *Theory of Equations;* Burnside and Panton's *Theory of Equations.*

Trigonometry.—Continuation of Junior Class work to trigonometrical ratios of angles of any magnitude, and of the sums of angles; multiple angles, division of angles, nature of trigonometrical tables and their use, principle of proportional parts, solution of triangles.

TEXT BOOKS—The *Elementary Trigonometry* of Walmsley or Lock; Todhunter's *Plane Trigonometry.*

FEE—£1 11s. 6d.

Senior Class

Monday, Wednesday, and Friday, 9—10 (during the Summer Session).

The subjects of this class will be open to modification as occasion may arise, but the general character of the work is as shewn below.

Trigonometry.—Demoivre's theorem and its general application to multiple angles, exponential values of sine and cosine, summation of series, inverse functions, factors of trigonometrical functions.

Text Books—Lock's *Higher Trigonometry;* Todhunter's *Plane Trigonometry.*

Differential Calculus.—A short course will be given as an introduction to the Integral Calculus; it will include limits, ultimate ratios, differential coefficients and their geometrical and mechanical representation, differentiation of various kinds of functions, maxima and minima, Taylor's theorem.

Text Books — Todhunter's *Differential Calculus;* Williamson's *Differential Calculus.*

Integral Calculus.—As far as time will permit, the following points will be taken:—Nature of an integral, geometrical, physical, and mechanical representation of an integral, integration by various methods, lengths of curves, areas of surfaces, volumes of solids.

Text Book—Todhunter's *Integral Calculus.*

Fee—£1 1s.

For those who have attended the Intermediate Class during the winter session the fee will be 15s.

Attendance in the Intermediate and Senior Classes will qualify for a certificate of attendance in reference to the degrees in Science of St Andrews University.

SATURDAY CLASSES FOR TEACHERS

A scheme of Saturday Classes for Teachers has been drawn up, and will be found on page 133.

NATURAL PHILOSOPHY

There are four Courses of Lectures offered in this subject. The first, which is adapted to the requirements of the Matriculation Examination in the University of London, embraces Mechanics and Hydrostatics. The second is a course in Experimental Physics, and embraces Sound, Light, Heat, Magnetism, and Electricity, taken under the heads indicated below. This course covers the whole of the above subjects, and is so arranged that in successive years the various main divisions receive in turn special attention, and will therefore be taken in the third term, to enable students to supplement previous work without being under the necessity of repeating the whole course.

The third course is an advanced class in Mathematical Physics, and the fourth is a course intended for teachers and others who may find it impossible to attend the ordinary day classes. See page 134.

COURSE I

MECHANICS

Tuesday and Thursday, 11—12.

This course will embrace :—

Kinematics—Geometrical notions—Definition, measurement, composition, and resolution of Velocity and Acceleration—Hodograph—Harmonic motion.

Kinetics—Definition and measurement of Force, Mass, Stress, Weight, Momentum, and Energy—Moment of Inertia—The Laws of Motion—Motion of bodies under the influence of gravity—Measurement of the acceleration of gravity—Atwood's machine—Impact.

Statics—Composition and resolution of Forces—The simple machines — Centre of parallel forces — Distributed Stress—Centre of mass—Friction.

Hydrostatics—Definitions—Laws of fluid pressure—Specific gravity—Boyle's law—The Barometer—Pumps—Capillarity.

The above syllabus includes the principles of elementary mechanics, and will occupy for its treatment the first two terms, and will therefore form a suitable course of study to those presenting themselves for the preliminary examination at St Andrews. The third term will be devoted to some special parts of the subject, and during the coming summer session the following will be treated :—

Graphic Statics.—Under this head the application of geometrical and diagrammatic constructions to the solution of problems in statics and kinetics will be considered in some detail. Thus the relations amongst the mutual forces between the parts of bodies in equilibrium; the distribution of stresses in jointed structures; the nature of the stresses in a suspended chain of any character, the representation of force, velocity, acceleration, etc., on a scale diagram; and the hodograph, will be considered.

Dynamics of Rotation.—Under this head the velocities of the various parts of rotating bodies; the distribution of stress arising therefrom; the composition of rotations; the instantaneous centre and axis of rotation; the centre of oscillation; and in general the more important theorems connected with the rotation of bodies will be considered in such detail as the time will permit.

In the above lectures no knowledge of Mathematics beyond the subjects taken in the Junior Class will be assumed on the part of the students.

TEXT BOOKS.—Blaikie's *Elements of Dynamics*; Lock's *Elementary Dynamics*; Greaves' *Elementary Statics*; Besant's *Elementary Hydrostatics*.

FEE—£1 11s. 6d.

COURSE II

EXPERIMENTAL PHYSICS

Tuesday and Thursday, 10—11.

(1) *Sound*—The production, velocity, pitch, intensity, and quality of sound — Composition and resolution of vibrations — Resonance — Interference — Harmony — Musical intervals—Temperament.

(2) *Light* — Photometry—Laws of intensity of light—Velocity of light—Undulatory Theory—Reflexion—Refraction—Dispersion — Interference — Diffraction—Double refraction — Polarisation — The nature of common light — Colour — Optical instruments — Achromatism—Spherical aberration—Spectroscopy—Absorption—Spectrum analysis—Photography.

(3) *Heat*—Simpler phenomena—Conduction and convection—Specific and latent heat—Radiation—Elements of Thermodynamics—Mechanical equivalent of heat—Heat engines—Conservation of energy.

(4) *Magnetism*—Laws of magnetic action—Lines of force—Magnetic field — Magnetic potential — Magnetic induction.

(5) *Electricity*—Laws of electric action — Potential—Capacity — Induction —Condensers— Electrometers—Electromotive force — Currents — Batteries — Resistance—Ampère's laws—Induced currents—Electrolysis—Systems of units.

During the third term Magnetism and Electricity will receive special attention.

TEXT BOOKS—Ganot's *Physics;* Daniell's *Principles of Physics;* Deschanel's *Natural Philosophy;* Balfour Stewart's *Heat;* Tait's *Heat;* Thompson's *Magnetism and Electricity;* Fleeming Jenkin's *Magnetism and Electricity.*

FEE—£1 11s. 6d.

Those who desire to take the Magnetism and Electricity alone may join this class at the beginning of the summer term, for which the fee will be 15s.

Attendance in Mechanics and Physics will qualify for a certificate of attendance in reference to the degree in Science of St Andrews University.

COURSE III

MATHEMATICAL PHYSICS

In this Class, which, if formed, will meet once a week, some one of the following groups of subjects will be taken and treated mathematically, and experimentally as far as desirable. Acquaintance with the Differential and Integral Calculus will be assumed on the part of the Students.

1. Analytical Statics, Dynamics of a Particle, Rigid Dynamics.
2. Hydrostatics, Hydrokinetics, and Sound.
3. Thermodynamics, and Undulatory Theory of Light.
4. Electricity and Magnetism.

FEE—£1 1s.

COURSE IV

SATURDAY CLASSES FOR TEACHERS

A scheme of Saturday classes for teachers has been drawn up, and will be found on page 133.

THE LABORATORIES

Attendance in the laboratories is strongly recommended to all students of Natural Philosophy, as by this means alone they can become familiarized with the instruments and methods employed in investigating the physical and mechanical phenomena treated in the lectures.

There are two laboratories available for the use of students —the Physical Laboratory of the College and the Mechanical Laboratory of the Technical Institute.

The Physical Laboratory is fitted with the usual arrangements, and equipped with the needful instruments, either for laboratory practice or original research. The apparatus includes a dividing engine by Hicks, a very fine spectrometer by Hilger, a set of high-class electrical instruments, and some of the acoustical apparatus manufactured from the designs of Professor Helmholtz.

The Mechanical Laboratory is intended to supplement the classes in Mechanics by experimental verification on the part of students of the chief laws of motion, and of the relations between force, energy, momentum, and so forth. Actual measurements will be made of mechanical and hydrostatic quantities, such as, for example, centrifugal force, friction, internal stress in strained bodies, whether fixed or moving, co-efficients expressing physical properties of matter, velocities of fluid motion, resistance of fluids to bodies moving through them, etc.; see also page 159.

Such experiments and measurements, as far as is compatible with scientific sequence, will be directed in such manner as to prove a useful foundation for Engineering work.

Students who intend to prosecute their practical study of Natural Philosophy further than the time devoted to lecture

classes will allow, may become regular students in the laboratories for such days in the week as they may desire, on payment of the specified fees.

They will have the facilities of the Physical and Mechanical Laboratories placed at their disposal, and will receive the advice and assistance of the Professor and Demonstrator in the various manipulations which will be required, either in their tests and measurements, or in the construction of apparatus, or in their original work.

Students attending the Physical and Mechanical Laboratories for not less than 18 hours a week, will have the privilege of attending Course I. or Course II. free of charge.

A general course of Physical and Mechanical Laboratory work (including the special course referred to on page 83) can be obtained at the College. The following Syllabus will give an idea of its nature :—

1. Determinations of length, area, and volume by the rule, callipers, vernier, microscope, cathetometer, wire-guage, spherometer, planimeter, and by actual calculation.
2. Measurement of mass, weight, and density by the balance, spring balance, hydrometer, etc.
3. Measurement of kinematic quantities, velocity and acceleration, linear and angular; and kinetic quantities, force, momentum, energy, etc.
4. Measurement of statical quantities, such as friction, capillary attraction, fluid pressure.
5. Measurement of physical constants involved in the applications of mechanics, elasticity, torsion, etc.
6. Measurements of sound-wave lengths.
7. Measurement of velocities of sound in different media.
8. Determination of the laws of vibrating strings, rods, plates, and other bodies.

9. Methods of measuring temperature, including the calibration and graduation of standard thermometers.
10. Determination of specific and latent heat.
11. Measurement of expansions of solids, liquids, and gases.
12. Measurement of focal lengths of lenses and mirrors.
13. Photometry.
14. Measurement of angles of crystals.
15. Measurement of refractive indices.
16. Spectrum Analysis.
17. Determination of wave lengths of light.
18. Photography.
19. Electrical measurements, such as resistance, electromotive force, current-strength.
20. Magnetic measurements.

The first year's course will consist of such portions of the above syllabus as are required for the first examination in Practical Physics for the degree of B.Sc. at St Andrews University. It will include :—

(1) Simple measurements of length, area, volume, mass; (2) Mechanics.
(3) Elementary Optics, and
(4) Elementary Heat.

As much of these four divisions will be taken during the Winter Session as is possible. During the Summer Session junior, or first year, students will be allowed to vary their work in any special direction that may be desired by them and approved by the Professor.

The second year's course will consist of a development of the methods already practised either in the direction of greater elaboration of detail in the form of repetitions of

classical experiments in Physics, *e.g.*, those of Regnault, or in the special study of definite branches of the subject.

It is believed that Students of the University of St Andrews will be able by working six hours a week during the Winter Session to cover the ground of the prescribed examination in Practical Physics, and the third term will enable them, if successful in their examination, to make some progress towards the final examination in the following year should they elect to make Experimental Physics a subject for their degree.

Students who join the Laboratory with other intentions than that of working for the degree referred to are advised to follow the same course which has been drawn up in considerable detail, but if special circumstances require it, they will be allowed to modify the course in such a manner as may be approved and may most advantageously meet their special requirements.

For Students who have little or no previous knowledge of Natural Philosophy, a very simple Course has been arranged, which will occupy them for about six hours a-week during the Session.

TEXT BOOKS — Kohlrausch's *Physical Measurements*, Pickering's *Physical Manipulation*, Stewart & Gee's *Elementary Practical Physics*, Glazebrook & Shaw's *Practical Physics*, Sir R. S. Ball's *Experimental Mechanics*, Perry's *Practical Mechanics*.

Working Hours.—The Laboratory will be open for Day students daily from 10 A.M. to 4 P.M., except on Saturdays. Each student on entering will be allowed, subject to the approval of the Professor and to the regulations below, to arrange his working hours to suit his own convenience, but will be required to keep these hours when once fixed.

Junior students will be required to attend on Tuesdays from 2 to 4, and will not be allowed to attend on Wednesdays, except in the evening between 7 and 10 when the laboratory is open to day students as well as evening students.

The Fees for the Academical year will be as follows:—

For 6 hours per week,	£3	3	0,
Each additional hour per week,	0	10	6.

Day students may not enter for less than six hours a week. Students entering the laboratories during the second term will be charged two-thirds, and during the third term one-third of the above fees.

Students may also enter for short periods, working every day in the week, at the following fees:—

For One Month,	£2	12	6,
,, Two ,,	5	5	0,
,, Three ,,	7	7	0.

For Government Aid towards the Instruction of Science Teachers in Physics, see p. 53.

NOTE.—The laboratory fees include the use of apparatus, gas, and such chemicals as are required.

ELECTRICAL ENGINEERING

Arrangements have been made by the Professors of Natural Philosophy and Engineering for the giving of special instruction in Electricity and its practical applications, to suit the requirements of students who wish to supplement their general Engineering studies with a course of practical and technical Electricity, or to make Electrical Engineering a specialty.

The special course in this subject extends over two years, as follows :—

FIRST YEAR.—General Electricity — Included in the physical lectures (Professor STEGGALL).
Experimental Electricity in Physical Laboratory (Professor STEGGALL).

SECOND YEAR.—Electrical Engineering—Lecture Class (Professor EWING).
Electrical Engineering Laboratory (Professor EWING).

The First Year's work in this Course consists of attendance at a course of day or evening lectures in Magnetism and Electricity, and the subjoined laboratory course which will require attendance for six hours a-week during the Session :—

ELECTRICAL LABORATORY COURSE

1. General measurements of length, angle, mass, volume.
2. Simple measurements in mechanics and in light required as an introduction to electrical measurement.
   These two divisions (1 and 2) will occupy part of the first term.
3. Investigation of magnetic fields by mapping out lines of force, and determining the variation of strength from point to point.
4. Measurement of magnetic moments, and determination of the intensity and distribution of magnetization in magnets of various forms.
5. Determination of the elements of the Earth's magnetic field, and of the horizontal force in particular.
6. Study of the effects of temperature on magnetization.

7. Examination of the fields due to rectilinear and circular currents and measurement of current strength by the tangent galvanometer.
8. Study of Ohm's and Kirchhoff's laws concerning simple and meshed circuits.
9. Measurement of electromotive force by various methods.
10. Measurement of resistance by Wheatstone's bridge and other methods.
11. Calibration of galvanometers by comparison, by electrolysis, etc.
12. Determination of capacity and other electrical measurements involving the use of condensers.
13. Experiments with the quadrant electrometer.
14. Examination of the magnetic permeability and susceptibility of iron and steel specimens.
15. Measurement of co-efficients of induction.
16. Measurement of alternating currents.
17. Examination of the heating effect of currents on circuits.

FEE—£3 3s.

TEXT BOOKS—The books recommended for the Physical Laboratory work, and Kempe's *Electrical Testing*.

The Syllabus of the second year's classes will be found, p. 100.

(For Time Table, see next page.)

TIME TABLE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
9—10,	9—10,	9—10,	9—10,	9—10,	9—10,
Interm'diate Mathematics or Senior Mathematics	Junior Mathematics	Interm'diate Mathematics or Senior Mathematics	Junior Mathematics	Interm'diate Mathematics or Senior Mathematics	Teachers' Math. Class or Physical Class *
	10—11,		10—11,		
	Physics		Physics		
11—12,	11—12,	11—12,	11—12,		
Tutorial Mathematics	Mechanics	Tutorial Mathematics	Mechanics		

The Physical and Mechanical Laboratories are open every day, except Saturday, from 10 to 4. Special arrangements may be made for teachers and others who can only attend on Saturday and during the Evening.

***POSTSCRIPT**—JULY 1ST, 1889.—At the request, just received, of a large number of teachers, Professor Steggall will endeavour to form a class in Physics, partly in the evening and partly on Saturday during the winter session. The class will consist of at least 50 lectures, and arrangements will be made for it on Saturday, October 5th, 1889, at 7 P.M. This class may involve alterations in the evening and Saturday lecture classes. The fee will be £1 11s. 6d.

CHEMISTRY.

PROFESSOR PERCY FRANKLAND.

Assistant Lecturer and Demonstrator in the Chemical Laboratory, . } ANDREW THOMSON, M.A., D.Sc.

LECTURE ASSISTANT AND LABORATORY STEWARD—

JOHN FOGGIE.

NOTE.—The Lectures and Laboratory practice in Chemistry are recognised by the Royal College of Physicians, and the Royal College of Surgeons, London, and by the Royal College of Surgeons, Edinburgh, and for degrees in Science and Medicine by the Universities of St Andrews and Edinburgh.

The Courses are suitable for the Degrees of the London University and for the Civil Service appointments, and will also satisfy the requirements of Students in Pharmacy, and of Students who intend to become candidates for the Associateship of the Institute of Chemistry, so far as attendance at Lectures on General and Theoretical Chemistry is concerned. (See p. 82.)

LECTURE COURSES.

The Lecture Courses on Chemistry are arranged (1) to give a full exposition of the general principles of Chemical Science; (2) for the systematic study of the properties of the more important elements and their compounds; and (3) to indicate the chief applications of Chemical Science in the Arts and Manufactures.

The Lectures are thus intended both for Students of pure

Chemistry, as well as for those more especially interested in the practical applications of the Science, *e.g.*,

Manufacturers in general, especially Alkali, Soap, Manure, Glass, and Cement Makers.
Dyers and Bleachers.
Metallurgists.
Mining and Civil Engineers.
Builders and Architects.
Brewers and Distillers.
Gas Manufacturers, &c.

A Course of Instruction in Practical Chemistry in the Laboratory is strongly recommended to all who wish to obtain a sound knowledge of the Science, and the methods of applying it to useful purposes—the duration of such course depending upon the special wants of the Student.

The Professor will be glad to give any information to intending Students.

FIRST YEAR'S LECTURE COURSE.

INORGANIC CHEMISTRY (NON-METALS).

Lecture Hours—Monday, Wednesday, and Friday, from 10 to 11 a.m.

The Lectures will treat of:—(1) The General Properties of Matter, the Laws of Chemical Combination and Decomposition, the Atomic Theory and General Principles of Modern Chemical Philosophy; (2) the Properties of the Non-Metallic Elements and their more important Compounds.

In this course special reference will be made to the following subjects of practical importance:—The Atmos-

phere and the Principles of Ventilation; Combustion and the Calorific Value of Fuel; the Nature and Luminosity of Flame; the Manufacture of Gas and an account of the principal products obtained in the destructive Distillation of Coal; Natural Waters, their Composition and Fitness for Domestic and Manufacturing Purposes; the Manufacture of Sulphuric, Hydrochloric, and Nitric Acids, and of Bleaching Powder; the Theory and Practice of Bleaching; Explosions in Coal Mines; Nitrification and the principal changes taking place in Soil.

TEXT BOOKS.—Roscoe's *Elementary Lessons in Chemistry* (Macmillan, 4s. 6d.); Thorpe's *Non-Metals* (Collins, 3s.); and Thorpe's *Chemical Problems* (Macmillan, 2s.). And for more advanced reading, vol. i. of Roscoe and Schorlemmer's *Treatise on Chemistry* (Macmillan, 21s.); Frankland & Japp's *Inorganic Chemistry* (Churchill, 24s.)

FEE—£2 2s.

SECOND YEAR'S LECTURE COURSES.

I. INORGANIC CHEMISTRY (METALS).

Lecture Hours—Tuesday and Thursday, from 9 to 10 a.m.

(Winter Session Only).

This course will treat of (1) the General Principles of Chemical Science from a more advanced point of view than in the previous course; (2) the Metallic Elements and their more important Compounds, including the Principles of Metallurgy and the industrial applications of the Metals and their Alloys; the Chemical Action of Light and the Principles of Photography; the Manufacture of Gunpowder, Mortars, Cements, Glass, Earthenware, Mineral Pigments, Tin Plate, &c.

TEXT BOOKS.—Thorpe's *Metals* (Collins, 3s.); and for more advanced reading, Frankland & Japp's *Inorganic Chemistry* (Churchill 24s.), or Roscoe & Schorlemmer's *Treatise on Chemistry*, Vols. II., III., IV., and V. (Macmillan, 18s. per volume).

FEE—£1 11s. 6d.

II. ORGANIC CHEMISTRY.

Lecture Hours—Wednesday, from 9 to 10 a.m.
(Winter Session).

Tuesday, Wednesday, and Thursday, from 9 to 10 a.m.
(Summer Session).

This course will treat of the General Principles of the Chemistry of the Carbon Compounds; Compound Radicals, Isomerism, Constitution, the Synthesis, Decompositions, and general reactions of the several classes of Organic Compounds.

Amongst other matters of practical importance, special reference will be made to Brewing and Fermentation, Fats, Oils, Soap, Coal Tar, Aniline, and other Artificial Colours, &c.

Fee for the Course, £1 11s. 6d.; Fee for entire Second Year's Course (Inorganic and Organic), £2 2s.

A Course of Practical Organic Chemistry in the Laboratory has been specially arranged to illustrate the Lectures, and should, if possible, be taken simultaneously with the Lecture Course. For Practical Chemistry, see pp. 79—82.

TEXT BOOKS.—Remsen's *Organic Chemistry* (Macmillan, 5s.), and for more advanced reading Richter's *Organic Chemistry*, translated by Smith (Trübner & Co.).

Tutorial Classes will be formed under the direction of the Professor for recapitulation and correction of the written exercises given out in the Lectures. All members of the First and Second Year's Lecture Courses will be required to attend, unless specially exempted by the Professor.

Hours { For First Year's Lecture Course—Friday, 9—10 A.M.
For Second ,, ,, ,, ,, 10—11 A.M.

FEE—5s.

LECTURE COURSE ON ANALYTICAL CHEMISTRY.

Lecture Hour—Saturday, from 9 to 10 a.m.

This Course, though open to all, is intended chiefly for Laboratory Students. The Lectures will supplement the instruction in Practical Chemistry, and will treat of the principles of Chemical Analysis—including the methods of detecting the more important Organic and Inorganic Poisons.

All First Year's Laboratory Students are strongly recommended to join this Class.

TEXT-BOOK—Clowes' *Practical Chemistry* (Churchill).

FEE—£1 1s.

SATURDAY CLASSES FOR TEACHERS

(*See page* 134).

PRACTICAL CHEMISTRY.

The Chemical Department of the College is provided with Laboratories fitted with all the modern conveniences for the prosecution of the many branches of Practical Chemistry. In addition to the General Laboratory, there are special rooms for Weighing, for Combustions and Blowpipe Work, for Gas, Water, and Spectrum Analysis, as well as a separate Laboratory for Students engaged in original research.

The course of study pursued in the Laboratory is varied according to the particular object which the Student has in view, although no Student can be permitted to take up any special line of work until he has satisfied the Professor that he has gained a satisfactory and practical training in the Principles of Chemical Science.

The instruction in the Laboratory includes:—(1) A general course of Experiments illustrative of the leading Principles of Chemistry; (2) General Chemical Analysis (Qualitative and Quantitative); (3) the applications of Analytical Chemistry to the Arts, Manufactures, Agriculture, and Public Health; (4) the Preparation of Organic Compounds; (5) Original Research.

It is very important that Chemical Students should devote as much time as possible to the practical work in the Laboratory, whilst Second Year's Students should not fail to attend also a class in Practical Physics.

A Course of Practical Chemistry is also specially arranged for Students preparing for the Medical and Pharmaceutical Examinations (for full information concerning the Chemistry Classes for Medical Students see p. 141).

NOTE.—A three months' Course of Practical Chemistry in the College Laboratory is accepted by the University of Edinburgh for the degree of B.Sc. in the Department of Public Health.

TEXT BOOKS FOR LABORATORY USE—Ramsay's *Practical Chemistry;* Valentin's *Qualitative Analysis;* Thorpe's *Quantitative Analysis;* Frankland's *Agricultural Chemical Analysis;* Cohen's *Practical Organic Chemistry;* Allen's *Commercial Organic Analysis.* Sutton's *Volumetric Analysis.*

Working Hours.—The Laboratory will be open for Students daily from 9 A.M. to 4 P.M., except on Saturdays, when it will be closed at 3 P.M. Each Student on entering will be allowed to arrange his working hours to suit his own convenience, but will be required to keep the hours when once fixed.

SESSIONAL FEES FOR DAY STUDENTS—

The Fees for both Sessions will be as follows:—

For six hours per week,	£3	3	0
Each additional hour per week,	0	10	6

Day Students may not enter for less than six hours a week. Students joining the Laboratory during the Second Term will be charged two-thirds, and during the Third Term one-third of the above Fees.

Students may also enter for short periods, working every day in the week at the following Fees:—

For One Month,	£2	12	6
,, Two ,,	5	5	0
,, Three ,,	7	7	0

NOTE.—The above fees for the Chemical Laboratory include the use of a separate working table, cupboard, drawers, &c., chemicals, fuel, water, gas, and apparatus of a more expensive character. Each Student, however, will have to find his own ordinary apparatus, and a few of the more expensive reagents, a list of which is given below.

Set of Apparatus to be provided by each Student—

*Retort Stand, about 20 in. high, with 3 Rings.
*Filter Stand.
*Test Tube Stand.
*Tripod, about 8 in. high.
*Crucible Tongs.
Blowpipe (Brass),
Scissors.
Small Iron Triangle.
Cork Borer.
Triangular File.
Round File.
Bunsen Lamp.
*Sand Tray
Test Tube Brush.
Assorted Corks.
Two Towels.
India Rubber Gas Tubing, 2½ ft. (good quality).
,, Connection Tubing, 1 ft.
Filter Paper, ½ Quire.
Two Porcelain Basins, 4 in. and 3 in. diameter.
Two Porcelain Crucibles and Lids, 1¼ in. diameter
Mortar and Pestle.
Two 2-oz. Flasks.
Two 4-oz. Flasks.
One 16-oz. Flask.
Nest of 4 Beakers.
*2-oz Stoppered Retort.
1 Doz. Test Tubes, 5 in. × ⅝ in.
1 Test Glass on Foot.
2 Funnels, 3 in. and 2¼ in. diameter.
2 Funnel Tubes.
½ lb. Glass Tubing (assorted).

Piece of Wire Gauze.
1 India Rubber Stopper (2 perforations), 1 in. diameter.
2 ,, ,, (,,), $\frac{5}{8}$ in. diameter.
*$\frac{1}{4}$ oz. of Silver Nitrate and bottle.

**Evening Students are not required to provide those articles marked.* The cost of the whole set will be about 38s.; Evening Students' set, about 21s.

TEXT-BOOKS—Clowes' *Practical Chemistry* (Churchill); Thorpe's *Quantitative Analysis* (Longmans), 4s. 6d.

For Government Aid towards the Instruction of Science Teachers in Practical Chemistry, see p. 53.

A deposit of 2s. will be required from each Student on the receipt of the keys of his working table. This will be refunded when the key is returned.

Each Student will pursue an independent course of study, to be determined after consultation with the Professor, and such operations only can be allowed as belong to the course of study he shall mark out for each Student. *No other experiment* may be undertaken without his express permission, or, in his absence, of the Demonstrator, and in all cases the *methods* adopted must be such as are indicated by them. Every Student will be expected to keep his apparatus and working table clean and in good order, and to conform in all other respects to the rules of the department.

Course of Study recommended to Students preparing for the Associateship of the Institute of Chemistry.

FIRST YEAR.

1. Elementary Mathematics.
2. Elementary Physics.

3. Elementary Chemistry.
4. French.
5. German.

SECOND YEAR.

1. Special Course in the Physical Laboratory.
2. Chemistry—General Course of Lectures on Inorganic and Organic Chemistry.
3. Analytical Chemistry Lectures.
4. Chemical Laboratory.
5. French and German, if necessary.

THIRD YEAR.

1. Mineralogy, or Geology, or Technical Chemistry.
2. Chemical Laboratory.
3. Special instruction in Chemistry.

The following Course of Study is recommended to those Students intending to devote themselves to Applied Chemistry:—

First Year—Chemistry Lectures (First Course), and Tutorial Class.
Analytical Chemistry Lectures.
Chemical Laboratory—18 hours a-week.
Mathematics.
Elementary Physics.
French or German.

Second Year—Chemistry Lectures (Second Course), and Tutorial Class.
Technological Chemistry Lectures.
Chemical Laboratory—18 hours a-week.
French or German.
Mechanical Drawing.
Mathematics or Mechanics.

Third Year—Technological Chemistry Lectures.
Chemical Laboratory—24 hours a-week.
Physical Laboratory—6 hours a-week.

DYEING, BLEACHING, and the CHEMISTRY of the TEXTILE FIBRES

PROFESSOR PERCY FRANKLAND AND DR THOMSON.

The full Course in Dyeing and Bleaching extends over from three to four years, and should be taken in its entirety by all who intend to take any part in the direction or management of Dye or Bleach Works.

FIRST YEAR.

	Hours per Week.	Fees.
Chemistry Lectures (1st Course), -	3	£2 2 0
Do. Tutorial, - - -	1	0 5 0
Chemical Laboratory—18 hours, -	18	9 9 0
Analytical Chemistry, - -	1	1 1 0
French or German, - - -	2	1 11 6
Experimental Physics—Lectures,	2	1 11 6
	27	£16 0 0

SECOND YEAR.

Chemistry Lectures (2nd Course), -	3	£2 2 0
Do. Tutorial, - - -	1	0 5 0
Chemical Laboratory, - -	10	5 5 0
Lectures on the Chemistry of the Textile Fibres, Bleaching, &c., -	2	1 11 6
Practical Work in the Dyehouse, -	12	6 6 0
French or German, - - -	2	1 11 6
	30	£17 1 0

THIRD YEAR.

	Hours per Week.	Fees.
Lectures on Colouring Matters and Dyeing, - - - -	2	£1 11 6
Practical Work in the Dyehouse, -	24	12 12 0
French or German, - - -	2	1 11 6
Mechanical Drawing, - -	6	3 3 0
	34	£18 18 0

FOURTH YEAR.

Special Work in the Dyehouse, -	24	£12 12 0
Physical Laboratory, - -	6	3 3 0
	30	£15 15 0

All Students before undertaking practical work in the Dyehouse will be required either:—(*a*) to have attended at least the First Lecture Course in Theoretical Chemistry, and to have had no less than one year's practical instruction in the Chemical Laboratory of not less than 12 hours a-week, and to attend (if they have not previously done so) concurrently with their first year in the Dyehouse the Second Course of Chemistry Lectures, and to take not less than 10 hours a-week in the Chemical Laboratory.* Or (*b*) to furnish evidence satisfactory to the Professor that they have received elsewhere instruction indicating a sufficient knowledge of Theoretical and Practical Chemistry. It is absolutely necessary that a Student should have an adequate knowledge of Elementary Chemistry before commencing the Dyeing and Bleaching Course, otherwise he cannot follow the latter with advantage. In no case can this be dispensed with excepting under very special circumstances.

* The work in the Chemical Laboratory at this time will consist of the analysis and valuation of the materials used in dyeing and bleaching.

LECTURE COURSES.

First Course.—THE CHEMISTRY OF THE TEXTILE FIBRES, SIZING, BLEACHING, AND SCOURING.

FEE—£1 11s. 6d.

This Course is suitable not only for dyers and bleachers, but for those who are engaged in the manufacture of jute, flax, and other fibres, and should be introductory to a general Course of Spinning and Weaving. It is also suitable for paper makers.

SYLLABUS.—Cellulose—Its general properties and relation to the various vegetable fibres. Chemical and microscopical methods of examining the structure and properties of fibres. Classification of fibres. Comparison of the animal and vegetable fibres used in the textile manufactures, with their chief points of difference.

General characters of vegetable fibres, especially jute, flax, hemp, and cotton, with an account of their origin, culture, chemical, physical, and microscopical characters, the action of chemical agents, preparation of the raw material for spinning and weaving, affinity for colouring matters, &c. Also a corresponding account of the animal fibres, wool and silk.

Bleaching, Scouring, and Finishing—Cotton, flax, jute, wool, and silk.

Sizing—The materials used, and the mode of applying them.

Water and its application to Bleaching, Scouring, and Dyeing. Action of impurities Methods of testing and correcting natural waters.

Packing and Packing Materials.

Mildews and Discolorations on cloth, yarn, &c. Detection and prevention.

Methods of Analysing undyed cloth and yarn.

NOTE.—The Lectures, while giving a general account of all of the most important fibres used in the textile manufactures, will of course treat especially of those which are of greatest interest to the district.

Second Course.—THE CHEMISTRY OF DYEING (Natural Colouring Matters).

*Lecture Hours—Thursdays, 7—8 p.m.**

This Course will treat of:—(1) The Theory of Dyeing; (2) Mordants—their preparation, action on, and application to the various Textile Fibres; (3) the Natural Colouring Matters, Vegetable and Animal.

Indigo—Origin, Preparation, and Chemical Properties. Indigo Vats. Indigo Extract.

Logwood—Origin, Preparation, Properties. Colours obtained with different Mordants.

Brazil Wood and kindred Redwoods—Origin, Preparation, and Properties; Application.

Barwood and its Allies—Origin, Use, &c.

Cochineal—Origin, Nature of Colouring Matter, different Methods of Application in Dyeing.

Culbear and Orchil—Origin, Manufacture, Character of the Colours produced.

Turmeric—Source, Properties of Colouring Matter, and Use in Dyeing.

Fustic—Young and Old, Properties and Uses.

Catechu—Source, Properties, Mode of Application, and Character of Colours produced.

Other Natural Colouring Matters as time may allow.

FEE FOR THE COURSE—7s. 6d.

*During the present Session this Class will be held in the Evening.

Third Course.—DYEING (Artificial Colouring Matters—Coal Tar and Mineral Colours).

(During the present Session the Second Course only will be given).

PRACTICAL WORK IN THE DYEHOUSE.

The Dyeing Laboratory is fitted up with every convenience for practical work in Dyeing and Bleaching, and it is hoped that similar arrangements may shortly be made with regard to the printing of jute, cotton, and other fabrics. The main object of the instruction will be to make the Student practically acquainted not only with the chief processes employed in Dyeing and Bleaching, but more especially with the general principles underlying the art of colouring and bleaching textile fibres. The Student will learn how to determine the value and quality of Dyeing and Bleaching materials, and to investigate their properties, and he will be taught how to find the most economical and effective means of producing any given effect.

The Courses are suitable for the Technological Examinations of the City and Guilds of London Institute.

Working Hours.—The Dyehouse will be open for Students daily from 9 A.M. to 4 P.M., except on Saturdays. Each Student on entering will be allowed to arrange his working hours to suit his own convenience, but will be required to keep the hours when once fixed.

SESSIONAL FEES FOR DAY STUDENTS (October to June)—
For 6 hours a-week, £3 3s., and 10s. 6d. for each additional hour.

Students may not enter for less than 6 hours a-week, and it is not advisable to take less than 12 hours. Students joining during the Second Term will be charged two-thirds, and during the Third Term one-third of the above Fees.

Students may also enter for short periods, working every day in the week, at the following Fees:—For one month, £2 12s. 6d.; for two months, £5 5s.; for three months, £7 7s. The above Fees include the use of a separate work-table, gas, steam, mordants, dyes, and other chemicals, but each Student will have to provide himself with the following set of apparatus:—(1) Six Porcelain Basins, (2) Six Glass Rods, (3) Two Towels, (4) Two Cleaning Sticks, (5) Large Porcelain Basin, (6) Bone Spatula, (7) Box of Weights, (8) Thermometer, (9) Hydrometer, (10) Sample Book. The cost of this set will be about 30s. Each Student will likewise be charged a small fee for the cloth, yarn, or other fabric which will be supplied to him for his experiments; he will also be required to leave a deposit of 1s. on the receipt of the key of his cupboard; this sum will be refunded when the key is returned. Each Student will work independently of others, and will have his own work-table, dye-vessels, and other necessary apparatus.

During the first year of the Course in Practical Dyeing (second year of full Course) the Student will be engaged in making an extended series of Dyeing experiments on the small scale, for the purpose of learning by systematic trials the properties of the various natural colouring matters, studying at the same time the effects of temperature, time, and different mordants, thus learning from his own experiments the best conditions for obtaining any given result in the most economical and effective manner. Concurrently with the practical work in the Dyehouse, the Student will be taught in the Chemical Laboratory the methods for testing the commercial value of bleach and dye wares, and the preparation of mordants, water analysis, &c. During the second year in the Dyehouse (third year of full Course), instruction will be given in the methods of applying artificial colouring matters, the Dyeing of compound shades, &c.;

also, the processes to be employed in the detection of colouring matters on dyed materials, and the detection of the various fibres in mixed fabrics. A third year in the Dyehouse may be devoted to special work in any branch of Dyeing or Bleaching.

TECHNICAL MUSEUM.

Connected with the Chemical, Dyeing, and Bleaching Department, the Professor is organising an extensive Technical Museum, containing a large collection of specimens illustrating many branches of Applied Chemistry, and particularly the local industries. In this collection the textile manufactures have naturally the first place. The exhibits, however, are not confined to the textile manufactures, but also embrace tanning and paper-making materials, oils, resins, varnishes, agricultural and other products, besides specimens illustrating various metallurgical processes, &c. Altogether, there are already over 8,000 specimens, including Dr Forbes Watson's collection of Indian products, a great part of which was brought together as an official duty for the India Museum, and was presented by the Department to Dr Watson when that Museum was broken up, and subsequently purchased and presented to the College by Mr William Carnelley, of Manchester. The College Museum also includes a large collection of fibres which formed part of the late Indian and Colonial Exhibition, and presented to the College by the Directors of the Royal Gardens, Kew; and many other special collections contributed by local and other firms.

This Museum, instead of seeking to exhibit attractive specimens, is essentially practical and educational. It is for the Student, and not for the casual visitor. Its object is to exhibit such characteristic and typical specimens as will

illustrate the various stages and processes in Bleaching, Dyeing, and other operations connected with the textile manufactures, as well as those of other local industries, and which will at the same time be of real practical interest to those engaged in the trade of the district.

Students will have free access to the Museum at all times when the Laboratory is open, and those who attend the Courses in Dyeing and Bleaching will be expected to make ample use of it in connection with their general work. Others who may not be Students of the College are also invited to avail themselves of the advantages of this Museum, which, it is hoped, may in time become the nucleus of a large Technical Museum of the Local Industries, similar to the Museums which, at Crefeld and other places on the Continent, have rendered such signal service to the trade and manufactures of those districts in which they are situated. Admission to the Museum is free and without ticket, but both Students and Visitors will be required to sign their names in a book on each visit.

TIME TABLE OF DAY CLASSES IN THE CHEMICAL AND DYEING DEPARTMENTS.

	MONDAY.	TUESDAY.	WEDN'SD'Y	THURSDAY.	FRIDAY.	SATURDAY.
A.M. 9—10.		Chemistry Lectures, 2nd Course.	Chemistry Lectures, Organic.	Chemistry Lectures, 2nd Course.	Tutorial, 1st Course.	Analytical Chemistry Lectures.
10—11.	Chemistry Lectures, 1st Course.		Chemistry Lectures, 1st Course.		Chemistry Lectures, 1st Course.	
P.M. 7—8.				Dyeing.	Tutorial, 2nd Course.	

The Chemical Laboratory and Dyehouse are open daily from 9 a.m. to 4 p.m., except on Saturday, when the Laboratory closes at 3 p.m., and the Dyehouse at 1 p.m.

ENGINEERING.

PROFESSOR EWING.

ASSISTANT AND LECTURER ON DRAWING—THOMAS REID.

This Department comprises—

I. & II. Junior and Senior Courses of Lectures, extending over two years, on the general Theory of Engineering, suitable for Mechanical or Civil Engineering Students.

III. A Course of Lectures and a Course of Field-work Practice in Surveying, Levelling, and Setting-out.

In the coming Session this Class will not be held, but instead of it there will be offered:—(IIIA.) A Special Course of Lectures on the Application of Graphic Statics to Engineering Problems.

IV. Practical Laboratory instruction in Mechanical and Civil Engineering for Junior and Senior Students.

V. A Course of Lectures on Electrical Engineering.

VI. Practical Laboratory instruction in Electrical Engineering for Senior Students.

VII. Instruction in Engineering Drawing and Machine Design for Junior and Senior Students.

Students of Engineering are advised to let their College Course precede rather than follow their apprenticeship or other training in Engineering Practice, whenever that is possible.

Attendance during three years on the Engineering and other Science Classes of this College qualifies for the Degree of B.Sc. in Engineering, granted by the

University of St Andrews. The course of study followed suits the examinations for this Degree. (See p. 233.)

Attendance on the Classes of this College is also recognised as qualifying for the Degree of B.Sc. in Engineering granted by the University of Edinburgh, to the extent of two out of the three years' course required.

I. JUNIOR ENGINEERING.

LECTURE CLASS.

Tuesday and Thursday, 12 to 1, and Friday, 11 to 12, during the Winter Session.

Short preliminary Course on principles of Dynamics. Ideas of Velocity, Acceleration, Mass, Force, Momentum, Energy, Power. Graphic methods of treatment. Principle of work. Applications to simple machines. Stress. Distributed Stress. Centre of Gravity. Pressure of Fluids. Equilibrium of floating bodies. Friction.

Simple applications of principles of Statics to determine the forces on the parts of engineering structures. Polygon of forces. Bridge and roof frames. Methods of reciprocal figures. Equilibrium of hanging chain. Funicular polygon.*

Stability of retaining walls and embankments. Pressure of earth.

Strength of Materials (elementary notions)—Tensile, crushing, and shearing strength. Factor of safety. Simple applications. Elasticity. Modulus of elasticity. Toughness. Methods of testing. Testing machines. Manufacture and properties of the materials of engineering: iron, steel, &c.

* During the Session 1889-90 this part of the Syllabus will be no more than touched upon, as the subject will be treated fully in the Special Course IIIA., which all junior students of Engineering are expected to attend as a supplement to the Junior Class.

Kinematics of Mechanism. Connected pieces. Velocity ratio. Rolling contact. Friction gear. Belt and rope gear. Sliding contact. Teeth of wheels. Cams. Link-work. Parallel motions. Quick return motions. Slider-crank chain. Simple harmonic motion.

Kinetics. Energy of moving bodies. Work done in producing motion. Influence of friction. Centrifugal force. Applications to speed governors, railway curves, &c. Rotations. Fly wheels. Work done in the cylinder of a steam engine. The Indicator. Work done on the crank.

Production of power. Prime movers. Transmission of power. Methods of transmission. Measurement of power. Dynamometers.

Workshop appliances. Machine tools.

Exercises are prescribed weekly, and are returned after correction by the Professor.

Special attention is given to graphic methods of solving practical engineering problems.

FEE—£1 11s. 6d.

Junior Students are expected to take the Course in Graphic Statics (IIIA. below) as the continuation of their engineering study into the third term.

II. SENIOR ENGINEERING.

LECTURE CLASS.

Monday, Wednesday, and Friday, 10 to 11.

Strength of materials and Theory of structures. Measurement of strength and elasticity. Effects of repeated load. Choice of factors of safety. Experimental data. Applications to ties and struts. Beams. Bending moments and shearing forces. Forms of beams. Deflection of beams.

Cantilevers. Continuous girders. Frames. Method of sections applied to bridge frames. Suspension bridges. Strength of boiler shells and pipes. Boiler stays. Rivetted joints. Strength of shafts. Twisting. Combined twisting and bending. Crank-shafts.

The Steam Engine. Historical sketch. Theory of heat-engines. Laws of thermodynamics. Perfect gases. Carnot's cycle. Reversibility. Stirling's air engine. Properties of steam. Action of steam in the cylinder. Indicator diagrams. Use of the indicator. Efficiency of steam engines. Methods of testing efficiency. Condensation and re-evaporation of steam in the cylinder. Influence of the steam-jacket. Superheating. Compound engines. Advantages of compounding. Forms of compound engines. Intermediate receiver. Triple and quadruple compound engines. Production of steam. Boilers. Types of boilers. Distribution of steam. Valves and valve motions. Zeuner's diagram. Expansion valves. Link motions. Corliss gear. Governors and fly wheels. Crank-effort diagram. Efficiency of the mechanism. Types of steam engines. General arrangement of stationary, marine, and locomotive engines. Compound locomotives. Explosive gas engines; Otto's, Clerk's, Atkinson's, &c.

Hydraulics. Flow of water in pipes. Discharge from orifices. Gauging. Hydraulic motors. Hydraulic machinery. Hydraulic transmission of power.

Sanitary engineering. Treatment of sewage. Domestic sanitary appliances. Ventilation and heating. Mechanical ventilation.

Exercises are prescribed weekly, and are returned after correction by the Professor.

FEE—£2 2s.

III. SURVEYING, LEVELLING, AND SETTING-OUT.

This Class will not be held during the coming Session, its place being taken by the Special Course IIIa. below. It will next be held in the Summer term of 1891.

The Course will comprise—

(1) Lectures on the Methods and Instruments used in Surveying, Levelling, and Setting-out, and on the Adjustment of Instruments.

(2) Field-work, in which the Students will make a Practical Survey by several methods.

(3) Drawing Plans, &c., of the Surveys.

The Field-work will go on continuously and daily (except on Saturdays) for two or three weeks, during which the Students must give their whole time to the work.* When it is finished they will be allowed the use of the Drawing Office for the preparation of their Plans, &c.

FEE—£2 2s.

* Arrangements are made by which the field-work may interfere as little as possible with the Students' other studies.

IIIa. SPECIAL COURSE ON THE APPLICATION OF GRAPHIC STATICS TO ENGINEERING PROBLEMS.

Monday, Wednesday, and Friday (in the Summer Term only), 9 to 10 a.m.

A Special Course of Lectures will be offered during the Summer Term of 1890 on Graphic Statics and the application of Graphic Methods to the solution of Engineering Problems. The importance of this subject to civil engineers

and architects, as well as to mechanical engineers, justifies the hope that this Class may be largely attended by pupils and assistants in engineers' and architects' offices, as well as by ordinary students in the Department of Engineering; and the Class is offered at an hour which has been chosen to make this practicable. Exercises will be given in practical problems. Junior Engineering Students are expected to take this Class as a continuation of the Class I. above.

The lectures will treat of :—

Graphic methods of representing and dealing with the quantities used in engineering calculations.

Treatment of force by graphic methods.

The funicular polygon or link polygon and its uses. Relations of the force polygon and the link polygon.

Applications to hanging chains and suspension bridges.

Applications to frames. Method of reciprocal figures to find the stresses in the members of a loaded frame. Types of bridge girders and roof frames. Effects of travelling load. Effects of wind pressure. Strength of ties and struts. Stiffness. Use of semi-members in bracing.

Beams. Diagrams of bending moments and shearing forces. Use of the funicular polygon to determine the forces at the supports and the bending moments. Diagrams of load and curvature. Deflection of loaded beams.

Continuous beams treated by graphic methods. Cantilevers and cantilever bridges.

Equilibrium of arches and buttresses, and retaining walls for water or earth.

Use of graphic methods in finding centres of gravity and moments of inertia, and in other calculations.

Application of graphic methods in mechanism to determine the relation of the driving force to the resistance, and to find the efficiency. The dynamic frame and its uses.

The first Lecture will be given on Monday, 14th April, at 9 o'clock.

FEE—£1 1s.

IV. ENGINEERING LABORATORY.

A large Laboratory has been fitted up with ample means for practical experiment and research in engineering. The equipment includes a Wicksteed testing machine, testing up to 50 tons in tension, compression, shearing and bending, with autographic recording apparatus for drawing diagrams of strain and stress; an experimental steam-engine, working up to 75 indicated horse-power, and arranged to work simple or compound, with or without a condenser, and with either surface or jet condensation; a high-pressure tubular boiler; a gas-engine, working up to about 10 horse-power; a set of machine tools; a mercury column for measuring pressure, up to 250 lbs. per square inch, and for testing the accuracy of pressure guages and indicators; a cement testing machine; and a large number of minor appliances for testing and experimental work, in addition to dynamo electric machines, and the apparatus of the Electrical Engineering Laboratory (VI. below).

Systematic instruction is given to Junior and Senior Students in the following work:—

Measurement of Lengths and Areas.

Measurement of the strength of the materials used in engineering under various modes of stress. Strength to resist tension, compression, and shearing and bending. Experiments on the strength of struts, beams, shafts, &c. Influence of time

and repetitions of loading on the strength of materials. Tests of iron, steel, timber, brick, stone, cement, &c.

Measurement of moduluses of Elasticity, by direct tension, bending, and twisting. Influence of form on the stiffness and strength of beams, &c.

Measurement of the amount and rate of plastic yielding of materials under stress.

Measurement of Power, by transmission and absorption dynamometers. Use of the Indicator, as applied to steam-engines and gas-engines. Compound indicator diagrams. Experimental study of compound steam-engine. Study of crank-effort diagrams.

Measurement of Pressure. Testing the accuracy of indicators and pressure gauges.

Measurement of heat supply and efficiency of engines. Experimental study of boiler. Consumption of fuel. Experimental study of properties of steam. Efficiency of gas-engines.

Measurement of coefficients of friction. Comparative value of lubricants. Friction of belts and rope bands. Friction of journals. Loss of Power in transmission.

Gauging the flow of water. Measurement of coefficients of discharge. Friction of fluids.

The Laboratory is open daily, but the students are required to attend on certain days which will be arranged when the class meets. Senior students must attend all day on Thursday. Special arrangements will be made to allow the use of the Laboratory to Advanced Students engaged in original research.

FEE—£3 3s. for six hours per week, and 10s. 6d. for each additional hour per week.

V. ELECTRICAL ENGINEERING.

Arrangements have been made by the Professors of Natural Philosophy and Engineering for the giving of special instruction in Electricity and its Practical Applications, to suit the requirements of Students who wish to supplement their general Engineering studies with a course of Practical and Technical Electricity, or to make Electrical Engineering a specialty.

The special Classes in this subject extend over two years, as follows :—

FIRST YEAR.—General Electricity — Included in the Physics Lecture Course (Professor STEGGALL).
Experimental Electricity in Physical Laboratory (Professor STEGGALL).

SECOND YEAR.—Electrical Engineering—Lecture Course (Professor EWING).
Electrical Engineering Laboratory (Professor EWING).

The Syllabus of the First Year Classes will be found on page 71 of the Calendar. The following is the Syllabus of the Second Year Classes.

ELECTRICAL ENGINEERING—LECTURE COURSE.

Lecture Hour—Thursday, 11—12 (during the Winter Session).

The Subjects treated will be :—

Practical Measurement of Electrical Quantities.
Production of Electricity; Primary and Secondary Batteries. Dynamo - Electric Machines — their Principles, Construction, and Regulation.

Distribution of Electricity. Efficiency of Leads. Current and Energy Meters. Transformers.

Electric Lighting. Arc and Incandescent Lamps.

Electric Transmission of Power. Efficiency of Electric Motors. Government of Motors.

Electric Tramways and Railways. Telpherage.

Telegraphy and Telephony. The Construction, Testing and Working of Land and Submarine Telegraphs.

FEE—15s.

VI. ELECTRICAL ENGINEERING LABORATORY.

A special Laboratory has been fitted up with the appliances required for the practical teaching of Electrical Engineering. The equipment comprises three Dynamo-Electric Machines, driven by the steam-engine and gas-engine in the Engineering Laboratory, Dynamometers, Electro-Dynamometers, Graded and other Galvanometers for the Measurement of Strong Currents, Potential Galvanometer, Mirror Galvanometers, Magnetometers, Quadrant Electrometer, and other apparatus for Cable Testing and for general Electrical Measurements, Thomson & Varley's Slides and other Resistance Coils, Tray Cells and other Batteries, Accumulators, Photometer, Electric Motors, a number of Arc Lamps of various types, Incandescent Lamps, &c., &c.

The course of instruction in the Electrical Engineering Laboratory will cover the same ground as that covered in the Lecture Course. Students will be familiarised with practical methods of electrical testing, and taught to measure currents, electromotive forces, resistances, the efficiency of dynamos, motors, and storage batteries, the ratio of candle-power to horse-power in electric lamps,

the conductivity, insulation, and capacity of conductors, according to the methods practised in cable factories and telegraph stations, &c. Attendance in the Laboratory is compulsory on all Students of Electrical Engineering.

FEE—£3 3s. for 6 hours per week, and 10s. 6d. for each additional hour per week.

The Laboratory is open to ordinary Students from 10 to 4.30 on Tuesdays, Thursdays, and Fridays. Arrangements may be made to open the Laboratory at other times if necessary.

The Electrical Engineering Laboratory is also open daily to Advanced Students, or others who wish to prosecute researches on matters relating to the industrial applications of Electricity.

VII. DRAWING.

The Engineering Department includes a Drawing Office, which is open for the use of Students daily (except on Saturday), from 10 A.M. to 4.30 P.M. Instruction will be given in Geometrical Drawing, and in the preparation of working Drawings in Mechanical and Civil Engineering.

Two systematic Courses of instruction are given, one suited to Junior and the other to Senior Students. Students are required to provide themselves with the drawing instruments and materials in ordinary use (except boards and T squares, which are supplied), and arrangements are made by which these can be obtained in the College at cost price. The Drawing Office is equipped with a number of other instruments of a more costly character, the free use of which is allowed to the Students. The machine tools in the Engineering Laboratory are made use of as subjects for drawing from measurement.

All Students of Drawing, Senior and Junior, are required to attend on Mondays and Wednesdays, from 1.30 to 4.30.

Two Lectures are given weekly, one for Senior and one for Junior Students, in which the following subjects are illustrated by demonstrations on the black-board :—

JUNIOR DRAWING CLASS.

Lecture Hour—Monday, 1.30 to 2.30.

Practical Plane and Solid Geometry. The application of Geometrical principles to Mechanical Drawing.

Projection.

Drawing of actual Machines from Measurement.

Drawing Office Practice.

Choice of Materials of Construction. Factors of Safety.

Design of Fastenings. Bolts and Nuts; Gibs and Cotters; Keys; Pin-and-Eye Joints; Rivetted Joints.

Gearing. Teeth of Wheels; Screws; Belt and Rope Gearing; Shafting and Pedestals.

SENIOR DRAWING CLASS.

Lecture Hour—Wednesday, 1.30 to 2.30.

Steam Engine Details. Pistons; Crossheads; Guides; Connecting Rods; Crank-shaft and Bearings; Eccentrics; Cylinders; Slide Valves, Expansion Valves; Corliss Gear; Zeuner's Slide-Valve Diagram.

Link Motions and Radial Valve Gear.

Condensers; Air Pumps; Circulating Pumps; Feed Pumps.

Boilers and Boiler Mountings.

Screw Propellers and Thrust-blocks.

Diagrams of Stress for Bridge and Roof Frames.

Constructive Details of Girders, Roofs, Piers, and Cranes.

Hydraulic Gearing.

Specifications and Estimates.

TEXT BOOK—Unwin's *Elements of Machine Design.*

FEE (for three terms, and inclusive of the Lecture Class) —£3 3s. for six hours per week, and 10s. 6d. for each additional hour per week.

THREE YEARS' COURSE IN ENGINEERING.

The following course of Study, extending over three years, and suitable for the Degree of B.Sc. in the Department of Engineering, is recommended to Students:—

FIRST YEAR—

Mathematics*—(Junior or Intermediate, according to the extent of the Student's previous knowledge).
Mechanics.*
Experimental Physics—Lecture Course.
Chemistry—First Course.
Chemical Laboratory.
Geometrical and Mechanical Drawing.*

SECOND YEAR—

Engineering—Junior Course.
Surveying, &c., during the Summer Session. (During Session 1890-91 Graphic Statics).
Engineering Laboratory.
Drawing.
Mathematics—(Intermediate or Senior).
Electricity — (Lecture Course by Professor STEGGALL).
Physical Laboratory, with special reference to Electricity.
Chemistry — Second Course, during the Winter Session only.

THIRD YEAR—

Engineering—Senior Course (and Surveying, if not previously taken).

*These subjects are specially necessary in preparation for the Class of Engineering.

Engineering Laboratory.
Drawing.
Senior Mathematics (or, if that has been already taken, then Mathematical Physics).
Electrical Engineering—Lecture Course.
Electrical Engineering Laboratory.
Technological Chemistry.

TEXT BOOKS AND BOOKS OF REFERENCE.

GENERAL ENGINEERING: — Rankine's *Applied Mechanics;* Cotterill's *Applied Mechanics;* Rankine's *Civil Engineering;* Rankine's *Steam Engine;* "Encyclopædia Britannica," Articles *Steam Engine* and *Strength of Materials*; Seaton's *Manual of Marine Engineering;* Rankine's *Machinery and Millwork;* Unwin's *Machine Design;* Kennedy's *Mechanics of Machinery;* Thurston's *Materials of Engineering;* Cotterill's *Steam Engine;* Fidler's *Bridge Construction;* Unwin's *Testing of Materials.*

SURVEYING, LEVELLING, AND SETTING-OUT: — Rankine's *Civil Engineering;* Heather's *Surveying Instruments;* Gillespie's *Surveying;* Haskoll's *Engineering, Field-Work,* &c.

GRAPHIC STATICS:—*The Principles of Graphic Statics,* George Sydenham Clarke; *Economics of Construction,* R. H. Bow; *The Elements of Graphic Statics,* A. Jay Du Bois; *New Constructions in Graphical Statics,* Henry T. Eddy.

ELECTRICAL ENGINEERING: — Jenkin's *Electricity;* Maxwell's *Electricity;* Thompson's *Dynamo Electric Machinery;* Clark and Sabine's *Electrical Tables;* Munro and Jamieson's *Pocket Book;* Gray's *Absolute Measurements in Electricity;* Ayrton's *Practical Electricity;* Dredge's *Electric Illumination;* Culley's

Handbook of Practical Telegraphy; Kempe's *Handbook of Electrical Testing;* Prescott's *Electric Telegraph; The Electrician; The Electrical Review,* &c.

DRAWING:—Unwin's *Machine Design;* Ripper's *Machine Drawing and Design;* Tompkin's *Machine Construction;* Burn's *Building Construction;* Winter's *Geometrical Drawing;* André's *Draughtsman's Handbook;* Angel's *Practical Plane and Solid Geometry;* Winton's *Modern Steam Practice,* &c.

SMART BURSARY IN ENGINEERING.

The Examination for this Bursary will commence on Thursday, 3rd October, at Nine o'clock. Notice of intention to compete must be sent to the Principal on or before September 30th. For particulars, see p. 48

TIME TABLE OF DAY CLASSES IN THE ENGINEERING DEPARTMENT (WINTER SESSION).

	MONDAY.	TUESDAY.	WEDNESDAY	THURSDAY.	FRIDAY.
A.M. 10—11.	Senior Engineering.	Engineering and Elec. Laboratories	Senior Engineering.	Engineering and Elec. Laboratories	Senior Engineering.
11—12.		Do.		Electrical Engineering.	Junior Engineering.
P.M. 12—1.		Junior Engineering.		Junior Engineering.	
1.30—2.30.	Junior Drawing Lecture.	Engineering and Elec. Laboratories	Senior Drawing Lecture.	Engineering and Elec. Laboratories	Engineering and Elec. Laboratories
2.30—4.30.	Drawing.	Do.	Drawing.	Do.	Do.

The Drawing Office and the Engineering Laboratory are open daily from 10 to 4.30.

The Electrical Engineering Laboratory is open on Tuesday, Thursday, and Friday, from 10 to 4.30. Arrangements may be made to open the Laboratory at other times if required, and it will be open every day to Advanced Students. In the Engineering Laboratory Senior Students are required to attend all day on Thursday, from 10 A.M.; and Junior Students on days which will be arranged when the Class meets.

In the Summer Term, Lectures on Graphic Statics are given on Monday, Wednesday, and Friday, from 9 to 10.

For Time Table of Evening Classes, see p. 170.

BIOLOGY.

PROFESSOR D'ARCY W. THOMPSON.

The ordinary Biological teaching in this Department is such as to fit Students for the 1st M.B. and 1st B.Sc. Examinations in Natural History in the Universities of St Andrews and Edinburgh; and for the B.Sc. Examination of the University of London, and other Examinations in Biology as defined in the English Universities.

The Lectures are recognised by the Universities of St Andrews and Edinburgh as qualifying for Graduation in Medicine and Science.

I. ELEMENTARY COURSE.

Lecture Hours—Monday, Wednesday, and Friday, 11—12.

The first Lectures of this Course deal with general problems of Animal and Plant Life—The nature and properties of protoplasm; the processes of respiration and nutrition; the structure and life-history of simple unicellular plants, such as Protococcus and Torula (yeast); and unicellular animals, as Amœba and Vorticella.

The rest of the Winter Session is devoted to systematic Zoology. The Lectures include the matter prescribed for Degrees in Medicine and Science in Edinburgh and St Andrews.

TEXT BOOKS—Packard's *Zoology* (Holt, New York, 12s.), or Alleyne Nicholson's *Zoology* (Blackwood).

FEE—Lectures, £1 11s. 6d.; Practical Class, £1 1s.

II. SUMMER COURSE.

Daily, 11—12. Laboratory Class, 12—1.

The Elementary Course in Zoology will be repeated during the Summer Session. The Course will consist of 50 Lectures, with practical work in the Laboratory. This Course is designed expressly for Medical Students, commencing in the Summer Session, and is intended to be strictly preparatory for the First Professional Examination in Natural History in the University of Edinburgh. See Appendix, p. 244.

TEXT BOOK.—Alleyne Nicholson's *Zoology* (Blackwood, 18s.)

FEE (including Practical Class)—£3 3s.

III. ADVANCED COURSE.

During the Session 1889-90 Professor D'ARCY THOMPSON will deliver a Course of Advanced Lectures on particular groups of animals. This Advanced Class will meet twice a-week, at a convenient hour, and will be free to students of the Laboratory. During the first term the Lectures will deal with the group of *Birds*. The hour suggested is 12 to 1, on Tuesdays and Thursdays.

FEE (to other than Laboratory Students)—£1 10s. per term.

IV. COMPARATIVE EMBRYOLOGY.

Monday, Wednesday, and Friday, 11—12.

A Practical Course in Embryology, dealing chiefly with the Development of the Chick, is conducted during the

Summer Session. This Class is open to Laboratory Students who have already attended a course in Biology or Zoology.

TEXT BOOKS—Foster and Balfour's *Embryology of the Chick* (Macmillan, 10s. 6d.).

FEE—10s. 6d.

V. BIOLOGICAL LABORATORY.

A Practical Class is provided in connection with the Elementary Lectures in this Department. In addition, the advanced Laboratory is open daily for study, or for the prosecution of original research. The Laboratory is fitted with all the apparatus and reagents necessary for Zoological research.

The Museum contains several thousand dissections and other preparations, forming a type-series illustrating the groups of the Animal Kingdom, and is especially rich in its series of invertebrates and fishes.

Under the title of *Studies from the Museum of Zoology in University College, Dundee*, an illustrated journal is now issued from the Laboratory, containing accounts of work done therein, and also papers contributed by naturalists elsewhere on specimens contained in the Museum.

FEE—For the whole Session, £3 3s.; per Term, £1 11s. 6d.

The Biological Library contains a collection of important text-books and monographs, sets of the following publications:—*Trans. Zool. Society; Publications of the Museum of Comparative Zoology, Harvard, Mass.; Fauna and Flora d. Golfes d. Neapel; Annales du Musée de Marseille; Mittheilungen a. d. Zool. Station d. Neapel; Zoologischer Anzeiger; Biologisches Centralblatt; Anatomischer Anzeiger; Journal of the Linnean Society;* and the recent and current

numbers of the *Quarterly Journal of Microscopical Science; Journal of the Royal Microscopical Society; American Naturalist; Studies from the Biological Laboratory of Johns Hopkins University; Zeitschrift f. wissenschaftliche Zoologie; Jenaische Zeitschrift; Archiv f. mikroskopische Anatomie; Archives de Biologie; Archives de Zoologie, Expérimentale et Générale; Morphologisches Jahrbuch; Arbeiten aus der Zool. Zoot. Inst. d. Universität Wien.*

The Library of the Dundee Naturalists' Society is now deposited in the Biological Department of the College. It contains sets of the *Challenger Expedition Reports; British Museum Catalogues; Publications of the Palæontographical Society; Proceedings of the Zoological Society; Geological Magazine;* and various other zoological, botanical, and geological memoirs and journals.

BOTANY.

PROFESSOR PATRICK GEDDES.

Summer Term, 1890.

FIRST YEAR'S COURSE.

No previous knowledge being assumed, this Course will be devoted to a general elementary survey of the subject, suitable to the needs of Students of Science and Medicine, whose special requirements for graduation, more particularly in the Universities of St Andrews and Edinburgh, will be kept in view and provided for. (See pp. 140 and 147). The Course consists of 50 Lectures, with corresponding Laboratory Practice, Physiological and Garden Demonstrations, and Field Excursions. The Lecture and Laboratory Notes are, as far as possible, supplemented by the preparation of illustrated summaries, and by the holding of periodic practice examinations.

The Course will be divided into sections as follows :—

INTRODUCTION (3 LECTURES)—LIFE AND MOVEMENT IN PLANTS.—Carnivorous Plants. Digestion, Movement, Sensitiveness. Sources of Literature of Subject. Climbing and Twining Plants. Movements of Plants generally.

SECTION 1.—LIFE HISTORY OF A TYPICAL PLANT (5 LECTURES).—(*a*) Vegetative System (Leaf, Stem, and Root); (*b*) Reproductive System (Flower).

SECTION 2.—INTRODUCTION TO SYSTEMATIC BOTANY (5 LECTURES)—Outlines of Classification. Leading Orders

of Morocotyledons: Liliaceæ*, with Amaryllidaceæ and Iridaceæ, Orchidaceæ*, Palmaceæ and Araceæ, Gramineæ.*

SECTION 3. — COMPARATIVE PHYSIOLOGY AND MORPHOLOGY (20 LECTURES).—(*a*) Leaf, Stem, and Root, their functions, structure, and adaptations in detail; (*b*) Inflorescence, Fruit, and Seed; (*c*) Vegetable Histology and Embryology.

SECTION 4.—Leading Orders of Dicotyledons (2 special lectures, but with regular demonstrations in Laboratory, Garden, &c., throughout the Course.)—Ranunculaceæ,* Cruciferæ,* and Papaveraceæ; Caryophylleæ, Geraniaceæ and Malvaceæ, Rosaceæ* and Leguminosæ,* Saxifragaceæ and Umbelliferæ,* Campanulaceæ and Compositæ,* Solanaceæ and Scrophulariaceæ, Labiatæ,* Urticaceæ, Amentiferæ.*

SECTION 5.—CRYPTOGAMIC PLANTS AND THEIR RELATION TO PHANEROGAMS (15 LECTURES).—Life Histories of the essential types:—(*a*) Algæ, Fungi and Lichens; Chara, Mosses, and Liverworts; Ferns and Horse-tails, Rhizocarps, Selaginella, and Isoetes: (*b*) the Gymnospermous Phanerogams (Cycads and Conifers); Consequent reinterpretation of the Flower.

Special attention is devoted to Vegetable Physiology, and the general Course of Lectures will again be supplemented by not fewer than 20 demonstrations. Facilities will be given for preparing or repeating the leading experiments.

FEE, 10s. 6d., remitted to Students attending the Lectures and Laboratory.

Students may also attend with advantage the Evening Lectures (see below), since these will be devoted to a fuller treatment of some special subject, this being in 1890 the Theory of Evolution.

*An order of special importance.

SECOND YEAR'S COURSE.

Students entering upon a more extended course of study (such as is required for the Second Examination for a degree in Natural Science) are recommended in the first place to go over their general view of the subject by help of the Lectures or otherwise, and to amplify and systematise their knowledge of each of the sections above outlined by more extended practical work and reading. Thus, taking as an instance the Phanerogamic natural orders, they will be expected to acquaint themselves more fully with the natural orders enumerated above, and with the general characters of the more important orders remaining, in so far as these can be illustrated from the Botanic Garden or by help of other easily procurable specimens. No regular course of advanced Lectures will be given, but for each section of the Course opportunities of fuller study will be arranged, and tutorial exposition, individual or collective as occasion requires, will be given daily. Students are urged, as far as possible, to take actual part in the work of the department by demonstrating, preparation of summaries and diagrams, museum or herbarium specimens, &c., and so prepare themselves for teaching and research.

Special assistance is also offered to all Students (whether of first or second year) who may be desirous of continuing their Botanical studies throughout the summer vacation.

FEE—Lectures and Laboratory, £2 2s., or £1 5s. for either, taken separately.

Advanced Laboratory, open from	9	to 1.30
Lecture,...	2	to 3
Junior Laboratory,...	3	to 5
Physiological or other Demonstrations,	4.30	to 5

SATURDAY CLASS.

Course of 10 Lectures on Botany for Teachers (10—1, beginning 19th April), with Demonstrations and Practical Work. This Course will deal specially with Botany as applicable in Schools.

FEE—Teachers, 10s.; Pupil Teachers, 5s.

CLASSICS AND ANCIENT HISTORY.

PRINCIPAL PETERSON.

Assistant Lecturer—GILBERT ELLIOT, B.A.

In this department the Language Classes are formed into two divisions, Junior and Senior, for both Latin and Greek. If a sufficient number of Students offer, the Principal will be glad to hold also an Advanced Class for the study and exposition of the more difficult Latin writers. The work of the Junior Classes is divided between exercise in Grammar and Composition, and the reading of selected authors. In the Senior Classes the instruction takes more of the lecture form, and authors are studied in connection with the Literature and History of their respective periods. Written exercises are regularly prescribed, the passages set for Composition or Translation being discussed in lecture when the exercises are returned; and, besides the work done in Class, Students are expected to prepare a given subject in Greek and Roman History, Literature, or Antiquities, for the Class Examinations. Occasional lectures, bearing on these subjects, will be delivered by the Principal in connection with the work of every Class.

Tutorial instruction is offered in connection with the work of the Junior Classes; and arrangements are made by which assistance is given, as far as possible, to individual Students who may be preparing for particular examinations, or who may be desirous of overtaking more advanced work. Special attention will be given, in the Day Classes, to the Degree Examinations of the University of London, and to the Open Competition for the Civil Service of India

The attention of Women Students is also directed to the Examinations held by the Universities of Oxford and St Andrews.

NOTE.—The following are the books prescribed for the London University Examinations:—

Matriculation—January 1890: Ovid, Metamorphoses, Book xi.; Tristia, Book iii.; Euripides, Hecuba.

June 1890: Cicero, De Amicitia, Pro Balbo; Xenophon, Hellenics, Book ii.

Intermediate—1890: *Pass*—Virgil, Georgics i. and ii.; Livy, xxi.; Sophocles, Antigone. The work for Honours includes Virgil, Horace, and selections from Plautus, Terence, Lucretius, Juvenal, Lucan, Cicero, Livy, and Tacitus.

B. A. Pass—Cicero De Oratore, Book ii.; Virgil, Aeneid, Books vii. to x.; Aristophanes, Plutus; Thucydides, Book iv.

Periods of Greek and Roman History are also prescribed for this Examination:—(1) From the Battle of Aegospotami to the Capture of Amphipolis by Philip; (2) from the Death of Augustus Cæsar to the Death of Domitian.

For the Subjects prescribed for the B.A. Honours Examination, consult the *Calendar of the University of London* (p. 82).

The Subjects prescribed for the L.L.A. Certificate in Honours at St Andrews are:—

1. *Latin Literature.*—(1) Plautus, Mostellaria and Rudens; (2) Lucretius, De Rerum Natura, Books v. and vi.; (3) Virgil, Georgics; (4) Tacitus, Annals, Books i.—iii.; (5) Passages from Authors not prescribed; (6) Latin Prose Composition; (7) Questions in History, Philology, and Antiquities.

2. *Greek Literature.*—(1) Six Books of Iliad or Odyssey; (2) Two Plays of Sophocles, and one of Aeschylus, or an equal portion of Pindar; (3) Two Books of Thucydides; (4) Demosthenes, De Corona, or an equal amount of Plato or Aristotle; (5) Translation from Greek authors not prescribed; (6) Greek Prose; (7) Questions in Philology, History, and Literature.

For the Oxford Examinations (see p. 246) selection is permitted from a large number of books.

GREEK.

JUNIOR CLASS.

Monday, Wednesday, and Friday, 2—3.

In this Class portions of some Greek authors — *e.g.*, Xenophon, Homer, Lucian, and Euripides, or Aristophanes

(an easy play)—will be read and explained. For preparation, Rutherford's *First Greek Grammar* and Young's *Proemia Graeca* may be recommended.

The Text-book used in the Class will be Sidgwick's *First Greek Writer*, or Jackson's *First Steps to Greek Prose Composition.*

FEE—£2 2s.

SENIOR CLASS.

Tuesday, Thursday, and Friday, 11—12.

The work of the Senior Class will be selected from the Greek dramatists, and from Thucydides, Plato, and Demosthenes. Special arrangements will be made for the study of the book prescribed for the Intermediate Examination of the University of London. Text-books recommended—Goodwin, *School Greek Grammar;* Sidgwick's *Introduction to Greek Prose Composition.*

For reference, the most valuable handbook is F. E. Thompson's *Syntax of Attic Greek,* of which an Elementary Edition is also published by Messrs Rivingtons.

FEE—£2 2s. Summer Session, £1 1s.*

The following books are also recommended for general use:—Abbott's *Outlines of Greek History*, or Cox's *General History of Greece;* Jebb's *Primer of Greek Literature;* Kiepert's *Manual of Ancient Geography;* Peile's *Primer of Philology.*

* Students of any Scottish University, and other Classical Students residing in the district during the long vacation, are invited to join this Class for the Summer Session only. The work will be selected with reference to their special needs—*e.g.*, Degree Examinations (Pass or Honours), Scholarships, &c.

LATIN.

JUNIOR CLASS.

Monday, Wednesday, and Friday, 12—1.

The authors read in this Class will be Cæsar, Livy, Sallust, Horace, and Terence or Ovid. The portions selected for study will be announced when the Class is formed, and will comprise as far as possible the work prescribed for the London Matriculation Examination and the St Andrews Preliminary Examination in Science. Students are expected to have at least an elementary knowledge of Latin Syntax and Accidence; and for preparation Abbott's *Via Latina* may be recommended.

For practice in composition, both oral and written, the Text-book in use will be Bradley's Edition of Arnold's *Latin Prose*, or Heatley's *Latin Prose Exercises.*

FEE—£2 2s.

SENIOR CLASS.

Tuesday, Thursday, and Friday, 12—1.

The authors read in this Class will be Virgil, Horace, Cicero, and Tacitus. The work will also embrace a systematic course of training in Latin Prose Composition and Translation at Sight. Special attention will be given to the subjects prescribed for the London Intermediate Examination.

TEXT-BOOKS—Roby's *School Latin Grammar;* Bradley's *Aids to Writing Latin Prose.*

FEE—£2 2s. Summer Session, £1 1s.*

The following books are recommended for general use:—Matheson's *Outlines of Roman History*, or Merivale's *General History of Rome;* Ramsay's *Elementary Manual of Roman Antiquities*, or Wilkins's *Primer;* Cruttwell's *History of Latin Literature.*

* Students of any Scottish University, and other Classical Students residing in the district during the long vacation, are invited to join this Class for the Summer Session only. The work will be selected with reference to their special needs—*e.g.*, Degree Examinations (Pass or Honours), Scholarships, &c.

ADVANCED CLASS.

This Class will meet twice weekly (if a sufficient number of Students present themselves) for the study and exposition of the more difficult Latin authors, such as Virgil, Tacitus, Lucretius, Catullus, Plautus, &c. Roman History and Literature will be treated in connection with the authors read in the Class, and the Written Examinations will embrace books prescribed for voluntary reading, as well as the work done in the Class.

FEE—£1 11s. 6d.

*** Tutorial work in connection with the Junior Classes will be arranged for as may be required; and in all the Classes, besides continuous exercise in Composition, opportunity will be given for the practice of Translation at Sight.

TEXT-BOOKS — Jerram's *Anglice Reddenda* (Second Series); or Turner's *Latin and Greek Passages.*

SATURDAY CLASSES FOR TEACHERS.

A scheme of SATURDAY CLASSES for TEACHERS has been drawn up, and will be found on page 135.

LITERATURE AND HISTORY.

The attention of Students is requested to a Course of Popular Lectures on ROMAN HISTORY, which will be delivered by the Principal in the first term of the WINTER SESSION, on Wednesday Evenings, from 8 to 9 o'clock. For Syllabus, see p. 175.

During the Second Term of the WINTER SESSION the Principal will give, on Wednesday Afternoons, a Course of Nine Lectures on "The Poets and Poetry of Greece." The following is an outline of the Course :—

Introductory. Growth of Greek Poetry: (1) Epic, (2) Lyric, (3) Dramatic. Epic Poetry—Homer and Hesiod. Elegiac, Iambic, and Lyric Poetry—Solon, Theognis, Sappho, Anacreon, Simonides, Pindar. Transition to the Drama at Athens. The Greek Theatre. Tragedy—Aeschylus, Sophocles, Euripides. Comedy—Old and New, Aristophanes and Menander.

Students are expected to provide themselves with Professor Jebb's *Primer of Greek Literature* (Macmillan, price 1s.). They need not possess any knowledge of Greek, the aim of the lectures in the Literature Courses being to bring the advantages of an acquaintance with Classical Literature within the reach of those who cannot undertake the systematic study of the ancient languages. Besides such illustrative volumes as those in Blackwood's series of "Ancient Classics for English Readers," Students will have access to a collection of verse translations of the Greek Poets, especially the Dramatists.

Attendance in this Course, which is open to the public without registration, is strongly recommended to all Students in the Classical Department. The hour proposed is 4 to 5.

FEE—10s. 6d.

LOGIC.

Lecturer—GILBERT ELLIOT, B.A., late Scholar of Lincoln College, Oxford.

Thursday, 10—11.

During the Winter Session a Course of Twenty Lectures will be delivered on the Elements of Logic. The following is a synopsis of the Course:—Scope and definition of Logic. Terms—their various kinds. The import and various kinds of Propositions. Opposition and conversion of Propositions, and Immediate Inference. The Predicables, Division and Definition. The Syllogism, its Moods and Figures. Reduction of the Imperfect Figures. Fallacies. Induction, Perfect and Scientific. Observation and Experiment, and the Methods. Hypothesis, Geometrical and Mathematical Induction, and Analogy.

TEXT-BOOK—Jevons' *Lessons in Logic* (Macmillan).

FEE—£1 1s.

ENGLISH LANGUAGE & LITERATURE AND MODERN HISTORY.

PROFESSOR GILRAY.

I. ENGLISH LITERATURE.

Mondays, Wednesdays, and Fridays, 4—5 p.m.

The work of this Class will consist (1) of sixty Lectures on the History of English Literature from 1580 to 1625. A preliminary sketch of the general History of English Literature will be given. The main part of the course will consist of an historical and critical account of the English Drama, especially in the reigns of Elizabeth and James I. An historical review of the leading events of the period, and a picture of the life and manners of the people, will be given, so as to show the relation of the literature to the political and social condition of the age.

The Class will also meet once a week for (2) the reading and study of a few selected English Classics. Attention will be paid not only to the meaning of the passages read, but also to philology, figures of speech, historical allusions, peculiar grammatical constructions, changes in the use and meaning of words, &c. Parts of Spenser and Shakespeare will be read; and other readings will be arranged, after the Class meets, to assist Students preparing for the L.L.A. Certificate, with Honours, at St. Andrews University.*

The Students will be expected (3) to give in to the Professor Essays on prescribed subjects. These will be carefully corrected, valued, and returned. (4) Examinations will be held at stated intervals on the Lectures and Class Readings.

* NOTE.—Candidates for the L.L.A. Certificate are recommended to take Classes I., IV., and V. For prescribed work, see page 129.

TEXT-BOOKS—No Text-book in English Literature is insisted on; but the Students may supplement the Lectures by using Brooke's *English Literature*, Morley's *First Sketch of English Literature*, or the new edition of Craik's *Manual of English Literature*, edited, "with an Additional Chapter on Recent Literature," by Henry Craik, M.A. For the Readings, Spenser's *Faery Queene*, Book I. (Clarendon Press), and Shakespeare's *Hamlet* (Clarendon Press) will be used. Text-Books for the other Readings will be announced as they are required.

FEE—£2 2s.

II. MODERN HISTORY.

Thursdays, 3—4 p.m.

(A) The period of Modern History selected for special study is the History of England from 1485 to 1688.

TEXT-BOOK.—Bright's *History of England*, Period II., Personal Monarchy, 1485-1688 (Rivingtons).*

(B) A Course of Lectures will be delivered on the History of the French Revolution. The Course will aim at presenting the best results reached by the leading French and English authorities.

*NOTE.—This Text-Book deals with the most important part of the History prescribed for the Matriculation Examination in Arts at London University. The Professor will be glad to superintend the studies of Students preparing for special examinations in History. For Subjects of Examination, see pp. 219—220.

FEE, £1 1s.

III. ENGLISH COMPOSITION AND RHETORIC.

Thursdays, 4—5 p.m.

The work of this Class is arranged as follows. (1) Opportunities will be given for Practice in English Composition. The exercises written in the Class-room will be examined by the Professor, carefully corrected, valued, and returned. In returning the papers, the Professor will make such remarks as he thinks may be useful to the Students individually and to the Class as a whole.

(2) More lengthy Essays to be done at home, and to be given in at stated intervals.

(3) The Professor will read extracts from the greatest masters of English Prose in illustration of the different Qualities of Style, and will aim at cultivating a sense of style and purity of taste in the Students.

(4) A systematic study of the rules of correct writing, and the principles of Rhetoric and Literature. Under this head a Course of Lectures will be delivered in expansion and illustration of the matter supplied by the Text-book.

(5) In addition to the portions discussed in the Class, parts of the Text-book will be prescribed for private study.

TEXT BOOK.—Bain's *English Composition and Rhetoric* (Longmans, Green, & Co.).*

FEE, £1 1s.

* N:B.—The edition used is the one published complete in one volume at 4s.

IV. HISTORY OF THE ENGLISH LANGUAGE.*

Saturdays, 11—12 a.m.

The work of this Class will consist (1) of a careful study of the structure and history of the English Language. (2) An English Classic will be read which throws light on the history and development of the Language. (3) A book will be prescribed for private study; and questions will be set on selected portions of it at each of the examinations.

TEXT-BOOKS.—Morris's *Historical Outlines of English Accidence* (Macmillan); Chaucer's *Prologue, Knightes Tale*, and *Nonne Prestes Tale*† (published in one volume, Clarendon Press); and, for private reading, Earle's *Philology of the English Tongue* (Clarendon Press).

† Chaucer's Prologue, &c., is prescribed for the L.L.A. Certificate with Honours, at St. Andrews University.

NOTE.—The English Language Class and the Modern History Class (see p. 123) are suitable for Students preparing for the London Matriculation Examination.

FEE, £1 1s. (for Teachers, 15s.)

V. ANGLO-SAXON OR OLD ENGLISH.*

Saturdays, 12—1 p.m.

The work of this Class will consist (1) of a careful study of the elements of Anglo-Saxon Grammar; and (2) of translation of Anglo-Saxon passages into English, with constant

* These Classes (IV. and V.) have been put on Saturdays, to suit the convenience of teachers and others who may be unable to attend on other days. Intending Students are recommended to take both Classes, *as some knowledge of Anglo-Saxon is essential to a sound understanding of the History of the English Language. Students who wish their studies to extend over two Sessions are strongly recommended to take Anglo-Saxon in their first Session.*

reference to the Grammar, so as to ensure thorough grounding in the elements. (3) A book will be prescribed for private study; and questions will be set on selected portions of it at each of the Examinations.

TEXT-BOOKS.— Sweet's *Anglo-Saxon Reader* (Fourth Edition, Clarendon Press); and, for private reading, Earle's *Anglo-Saxon Literature.*

FEE, £1 1s. (for Teachers, 15s.)

VI. CLASS FOR INTERMEDIATE LONDON EXAMINATION.

Wednesdays, 3—4 p.m.

A Class will be formed to assist Students preparing for the Intermediate Examination in Arts at London University (either Pass or Honours). In addition to Composition (for which see Class III., p. 124), the English subjects prescribed for 1890 are as follows:—

History of England from 1660 to 1714.
History of English Literature during the same period.
Milton: Paradise Lost.
Chaucer: Prologue, Knight's Tale, and Second Nun's Tale (Clarendon Press).
Dryden: Essay on Dramatic Poesy.
Addison: Essays on Milton in the *Spectator.*

TEXT-BOOKS.—Text-Books will be announced as they are required.

FEE, £1 1s.

NOTE.—The Professor will be glad to superintend the studies of students preparing for special examinations in English History and English Literature. The following are the Subjects prescribed for the London University Examinations:—

I. MATRICULATION EXAMINATION—1890.

The General History and Grammatical Structure of the English Language.

History of England to the end of the Seventeenth Century, with the Geography relating thereto.

[N.B.—Special stress is laid on correct spelling and grammar in the answers to the questions.]

II. INTERMEDIATE EXAMINATIONS IN ARTS—1890.

PASS.

The Grammatical Structure of the Language: Composition.
History of England from 1660 to 1714.
History of English Literature during the same period.
Milton: Paradise Lost.
Chaucer: Prologue, Knight's Tale, and Second Nun's Tale.
Dryden: Essay on Dramatic Poesy.*
Addison: Essays on Milton, in the *Spectator.**

[* Dryden's Essay is reprinted in Vol. 3 of Arber's "English Garner." Addison's Essays on Milton are collected in No. 8 of Arber's "English Reprints." These may be obtained of Professor Arber, 35 Wheeley's Road, Birmingham.]

HONOURS.

The Pass Subjects; and, in addition:
Milton: Comus.
Sweet: Anglo-Saxon Primer.
Havelock the Dane (Early English Text Society).*
Pope: Essay on Criticism.

[* Undergraduates *only* may obtain this book at a greatly reduced price, on individual application to the Society's Printers, Messrs Clay & Sons, Bungay, Suffolk].

III. B.A. EXAMINATIONS—1890.

PASS.

History of English Literature from 1625 to 1660.
Shakespeare: Hamlet.
Spenser: The Faery Queene.
Dan Michel: Ayenbite of Inwyt. (Early English Text Society.*)
Thorpe: The Anglo-Saxon Chronicle, Vol. I., from 800 to 1001 A.D. (pages 104 to 251): Two Texts only to be prepared, viz., C.C.C.C. 173, and Bodl. Land. 636. (Eyre & Spottiswoode, East Harding Street, London, E.C.)
Sweet: Anglo-Saxon Primer.

* See Note under Intermediate Examination.

HONOURS.

The Pass Subjects; and, in addition:
History of English Literature from 1660 to 1685.
Shakespeare: The Merchant of Venice.
Bacon: Essays, as published in 1625.
Bacon: History of Henry VII. Edited by Prof. Lumby. (Cambridge University Press.)
Hallam: Literature of Europe, as it bears on the 17th century.
Cynewulf: Elene. Edited by Prof. Zupitza. (Trübner & Co.)

INDIAN CIVIL SERVICE.

Notice Respecting the Examination in the History of England and English Literature.

(Changes in this Notice may be looked for in the forthcoming Volume of Regulations.)

HISTORY OF ENGLAND.

For the guidance of Candidates who may have a difficulty in making their selections for special study under this head, the following list is given as indicating the character and amount of reading that would be regarded as satisfactory.

Any one of the following periods, to be studied generally in "Bright's History," and particularly in portions selected by the Candidate, of the Text-Books named :—

1. Henry II. to Edward III., A.D. 1154-1477.—Stubb's Select Charters ; Stubb's Constitutional History of England.

2. The Tudors, A.D. 1485-1603.—Hallam's Constitutional History of England ; Froude's History of England.

3. The Stuarts, A.D. 1603-1714.—Hallam's Constitutional History of England ; Macaulay's History of England.

4. A.D. 1714-1805.—Lord Stanhope's History ; Sir T. E. May's Constitutional History ; *either* Massey's Reign of George III. *or* Lord Stanhope's Life of Pitt.

ENGLISH LITERATURE.

Under this head there will be (besides the general paper) a special paper on the following books :—

1. Chaucer.—Prologue and Clerk's Tale.
2. Shakespeare.—As You Like It, Antony and Cleopatra.
3. More.—Utopia.
4. Byron.—Childe Harold.
5. Burke.—Thoughts on Present Discontents, Reflections on the French Revolution.

The oral examination in English Literature will have reference chiefly to such works, not included in the foregoing list, as the Candidate may offer for the purpose.

UNIVERSITY OF ST. ANDREWS L.L.A. CERTIFICATE.

The following are the subjects for the Honours Examination in English Literature:—(1.) Shakespeare's Hamlet and Henry V.; (2.) Milton's Comus and Samson Agonistes; (3.) Sweet's Anglo-Saxon Reader, last edition, Sections I.—X., and XIV.—XX. inclusive (Clarendon Press). (4.) Chaucer: the Prologue to the Canterbury Tales; the Knightes Tale; the Nonne Prestes Tale, edited by R. Morris (Clarendon Press). (5.) Spenser's Faery Queene, Book I. (Clarendon Press). (6.) Burke's Reflections on the French Revolution. (Clarendon Press.) (7.) Pope's Essay on Man (Clarendon Press).

FRENCH.

LECTURER—M. H. DURLAC.

Tuesday and Friday, 3—4.

This Class will be entirely conducted in French; no Students should therefore join it who are not already pretty far advanced. The work will include preparation for the L.L.A. Examination in Honours at St Andrews and the B.A. Examinations for Honours at the London University, and the Books prescribed by the London University for special study will be used. These are:—

Brueys et Palaprat: *Le grondeur.*
Victor Cousin: *Du vrai, du beau et du bien.*
Thiers: *Campagne de Marengo.*
Victor Hugo: *Les Rayons et les Ombres.*

French Literature: *Poets, Dramatists, Historians, Essayists, and Philosophers of the XVIIIth Century.*

TEXT BOOK.—Geruzez: *Histoire abrégée de la littérature française,* supplemented by Lectures, in French, by M. Durlac.

Short Lectures will be given in French on historical grammar, and special attention will be given to etymological analysis.

TEXT BOOKS RECOMMENDED.—Brachet: *Dictionnaire étymologique;* Brachet: *Grammaire historique;* Chassang: *Grammaire française, cours supérieur.*

French Composition, both by written exercises and translations at sight, will also form an important part of the Course.

TEXT BOOKS.—Johnson's *Life of Pope;* Sheridan: *The Rivals.*

Dictionary recommended: Spiers, 2 vols.; or Hamilton, 2 vols.

*** This Class will meet in two sections. Students will be allowed to join either section, though they are recommended to enter for both. On Tuesdays the work will consist of Composition (*The Rivals*), chiefly at sight; Reading and Translation (*Brueys et Palaprat and Thiers*). On Fridays, Composition (*Johnson*); Reading and Translation (*Cousin*), Grammar, and Literature.

FEE—£1 11s. 6d. For each Section, £1 1s.

GERMAN.

LECTURER—M. H. DURLAC.

Tuesday and Friday 4—5.

A German Class, suited to Students preparing for th Associateship in Chemistry and attending the courses on Dyeing and Bleaching, will be formed at the above hours. Intending Students are requested to consult with M. Durlac.

FEE—£1 11s. 6d.

For Saturday Class for Teachers, see page 136.

FINE ART CLASSES.

Tuesdays and Fridays, 10—1.

Courses in Drawing and Painting will be conducted during next Session by Miss PATTI JACK, who proposes to offer instruction in the following subjects:—

Human Figure from Draped Life Model.
Still Life and Casts.
Landscape, Flowers, &c.
Oil and Water Colour Painting.
Charcoal and Pencil Work.

A Class may be formed in Summer for Sketching from Nature, and Painting in Oil and Water Colours.

FEES PER TERM (Twenty Lessons):—

Charcoal and Pencil Work from Casts, &c.,	-	£1	11 6
Oil and Water Colours, Life Work,	- - - -	2	12 6

SATURDAY CLASSES FOR TEACHERS.

A systematic Course of Classes for Teachers, mainly intended to cover the work for the London Matriculation

LECTURES ON THE DECORATIVE ARTS.

Arrangements are in progress for the delivery during the SECOND TERM of the Winter Session, beginning January 1890, of a Course of ART Lectures by Professor G. BALDWIN BROWN, of the University of Edinburgh.

The subjects treated of will include the following:—The Essential Characteristics of Decorative Art, and the Principles upon which it is based; the Chief Historical Styles of Ornament, with an Analysis of the Motives employed in each.

Opportunities will be given for Students to make sketches and notes from the examples used in illustrating the Lectures, and Exercises in Design will be set from time to time.

Particulars will be duly announced.

[illegible] will be found in the time-table at the end of the syllabus.

Each Class will be held only if a sufficient number of students come forward.

SATURDAY CLASSES.

I. CLASSES IN SCIENCE.

MATHEMATICS.—A Course of Twenty Lectures will be given in alternate years, and the matter treated will consist

of such portions of Elementary Geometry, Algebra, and Trigonometry as require the most careful explanation. Thus extensions of Euclid's theorems, riders, quadratic equations, ratio, proportion, the working of problems, the basis of measurement of angles, and such points, will chiefly receive attention.

TEXT-BOOKS—Any sound Elementary Text-Books on Euclid, Algebra, and Trigonometry, will be sufficient. See p. 58

MECHANICS.—A similarly arranged Course may be offered in alternate years in Mechanics. The Lectures will discuss elementary mechanical principles, with the least possible use of mathematical methods, and will treat of Motion, Force, Weight, Mass, Work, Energy, Composition of Motions and Forces, Equilibrium, Simple Machines, Properties of Matter, Elements of Hydrostatics.

TEXT-BOOKS — Lodge's *Elementary Mechanics;* Clerk Maxwell's *Matter and Motion.*

PHYSICS.—A similar Course will also be offered in Physics. The special branch taken up will be determined by consultation with the class; but, speaking generally, the consideration of elementary physical principles will form portion of this Course.

TEXT-BOOK—Balfour Stewart's *Elementary Physics.*

CHEMISTRY.—The Laboratory is open every Saturday, and if teachers wish any special instruction in addition, their wants will receive careful consideration, with a view to the formation of a Lecture Class. See p. 162.

BIOLOGY.—The Biological Laboratory is open on Saturdays for the sake of teachers especially. The Evening Lectures in this Department on Physiology are mainly devised to meet the wants of teachers, and may be combined with additional Laboratory work on Saturdays. In

the Summer Session, teachers who have attended the Classes in Biology, or who attend the Evening Class of Botany (p. 172), may attend the Saturday Botanical Excursions.

BOTANY.—A special class for teachers meets on Saturdays during the Summer Term, from 10—1, commencing April 19th. The Course includes laboratory work and excursions, as well as lectures. See pp. 114 and 172.

II. CLASSES IN LANGUAGE AND LITERATURE.

GREEK.—In this subject the teaching will be directed to giving members of the Class such elementary knowledge of the accidence and syntax of Greek as will enable them to translate easy Greek sentences, and to write exercises from some text-book for beginners. Students are recommended to prepare themselves for the Class by learning the declension of the substantives and the conjugation of the regular verb. Some reading will also be undertaken in the course of the Session.

Special arrangements will be made to assist any teacher who may be preparing the book prescribed for the June Matriculation Examination,—Xenophon, *Hellenics*, ii. But unless a sufficient number of students present themselves, it will be proposed to amalgamate this class with the Evening Greek Class, held on Tuesdays and Fridays.

LATIN.—The Principal will lecture next Session on a subject commonly read in Schools, the First Book of Cæsar's *Gallic War*. The aim of the Lectures will be to give teachers a higher knowledge of the idioms of Latin syntax, through the careful study of an author with whom they are expected to be familiar. Exercises in composition, arising out of the book read, will be regularly prescribed; and those who can undertake additional work will also have opportunity afforded them for practice in translation at sight.

ENGLISH.—The Classes in English are described in the College Calendar, pp. 125 and 126. They are two in number, and include the History of the English Language and Anglo-Saxon or Old English.

FRENCH.—The work of this Class will have for its aim to enable Teachers to qualify themselves for taking charge of French Classes in Board Schools or other Institutions, and will embrace a complete Course of French Grammar, treated historically, reading, pronunciation, translation from the best French authors in prose and poetry, recitation, French composition and conversation.

TEXT BOOKS.—Fivas' *Grammar;* Pressard, *Exercices de Récitation et de Lecture* (Hachette & Cie); Soulice, *Premières connaissances.* For French Composition: Kastner, *Elements of French Composition* (Hachette & Cie). Dictionary recommended, Gustave Masson (Macmillan & Co.).

GENERAL TIME-TABLE.

9—10, - - - -	Mathematics or Physics: Greek.
10—11, - - - -	Latin: French.
11—12, - - - -	English Language.
12—1, - - - -	Anglo-Saxon.

FEE for the Winter Session—10s. 6d.

Syllabus

OF

MEDICAL DEPARTMENT.

MEDICAL DEPARTMENT.

PRELIMINARY EXAMINATION IN GENERAL EDUCATION.—According to the regulations of the General Medical Council, it is necessary for every Student, at the commencement of his Medical studies, to be entered in the Register of the General Medical Council. Registration should be effected within fifteen days from the date of commencing professional study at a Medical School. Forms of Registration may be had on application to the Principal.

Students should bear in mind that the Preliminary Examinations recognised by the General Medical Council for Registration are only recognised *pro tanto* by the University of Edinburgh. For the degrees of the University of London it is necessary to have passed the Matriculation Examination of that University before the commencement of Medical study.

Students who are proceeding to the degrees of the Edinburgh University, and who begin their Medical studies in summer, may matriculate and attend the Classes in Natural History and Botany, *provided that the Preliminary Examination is passed and Registration is effected in the following October.*

For the Regulations regarding the Preliminary Examination of the Edinburgh University, see p. 240. For the Regulations regarding the Matriculation Examination of the London University, see p. 218.

ORDER OF STUDY.—As the Medical Classes at present conducted in University College have received recognition from the University of Edinburgh, it is expected that the majority of our Students will eventually proceed to the degrees of that University. It is advisable, therefore, to

subjoin here the recommendations of the University as to the course of study to be adopted.

Students are strongly recommended to begin their Medical studies in the Summer Session; and those who have the time at their disposal are advised to extend their course over five years.

FIRST SUMMER—

Preliminary Examination (if not previously passed).
Natural History.
Botany.

FIRST WINTER—

Anatomy.
Practical Anatomy.
Chemistry.
Practical Chemistry.

SECOND SUMMER—

Natural History.
Botany.
Practical Chemistry. } if not previously attended.
Hospital.

FIRST PROFESSIONAL EXAMINATION.—This Examination in Chemistry, Practical Chemistry, Natural History, and Botany, can now be passed whenever the courses of study in the various subjects are completed. Thus, a Student commencing his studies in the summer may go up for two subjects (Natural History and Botany) at the end of his First Summer, and may pass the remainder of the Examination (Chemistry and Practical Chemistry) at the end of his first Winter Session; or, a Student entering in the Winter may present himself in Chemistry and Natural History in April, and in Botany in July. See Appendix, p. 243.

CHEMISTRY.

Winter Session.

PROFESSOR FRANKLAND.

Medical Students are strongly recommended to take the complete Courses of Lectures on Inorganic and Organic Chemistry (see pp. 75 and 76), as well as to devote as much as possible of their available time during the first year to Practical Chemistry in the Laboratory.

The Chemical Classes intended to meet the requirements of Medical Students who purpose graduating at the University of Edinburgh are arranged as follows:—

(I.) 60 LECTURES ON INORGANIC CHEMISTRY.

From 10 to 11 a.m. on Monday, Wednesday, and Friday, from October to March.

These Lectures include:—Classification of Elements. General Laws of Chemical Combination and Action, as illustrated in the simpler compounds of the more commonly occurring elements.

Symbolic Notation.

Preparation and Properties of the Non-Metallic Elements and their chief Compounds.

Classification and General Properties of Acids, Bases, and Salts—Electrolysis of Salts.

Oxygen, Ozone, Oxidation and Reduction.

Hydrogen, Water, Peroxide of Hydrogen, Chlorine, Hydrochloric Acid, Hypochlorites, Chlorates, Perchlorates, Bromine, Hydrobromic Acid, Bromates, Iodine, Hydriodic Acid, Iodates, Periodates, Fluorine, Hydrofluoric Acid, Sulphur, Sulphuretted Hydrogen, Oxides of Sulphur,

Sulphites, Sulphates, Thiosulphates, Chlorides of Sulphur, Chloride of Sulphuryl, Nitrogen, The Atmosphere, Oxides of Nitrogen, Nitrates, Nitrites, Ammonia, Ammonia Salts, Phosphorus, Oxides of Phosphorus, Chlorides and Oxychloride of Phosphorus, Phosphates, Phosphites, Hypophosphites, Boron, Boracic Acid, Borates, Fluoride of Boron, Silicon, Silica, Silicates, Chloride of Silicon, Fluoride of Silicon, Hydrofluosilicic Acid.

A Tutorial Class in connection with the Lectures is conducted under the superintendence of the Professor.

(II.) 40 Lectures on Inorganic Chemistry (Metals).

From 9 to 10 a.m. on Tuesday and Thursday, from October to March.

The following metals, their Oxides, Sulphides, and more important Salts, will be dealt with:—Potassium, Sodium, Magnesium, Calcium, Strontium, Barium, Aluminium, Zinc, Cadmium, Manganese, Chromium, Iron, Nickel, Cobalt, Bismuth, Lead, Copper, Mercury, Silver, Tin, Gold, Platinum, Antimony, Arsenic.

(III.) 20 Lectures on Organic Chemistry.

From 9 to 10 a.m. on Wednesday, from October to March.

Carbon, Oxides of Carbon, Carbonates, Phosgene. Classification of Carbon Compounds. Marsh Gas and its Homologues. Chloroform. Methylic and Ethylic Alcohols and Ethers. Methylamine, Dimethylamine, Trimethylamine, Tetramethylammonium. Formic and Acetic Acids, Aldehyde, Acetone, Chloral, Olefiant Gas, Glycol, Oxalic Acid, Lactic Acid. Tartaric Acid, Citric Acid. Fats and Oils,

Saponification, Glycerine. Cellulose, Sugars, Starch. Products of Distillation of Wood and of Coal. Coal-Gas, Coal-Tar. Turpentine, Camphor. Benzene, Benzoic Acid, Salicylic Acid, Oil of Bitter Almonds. Hydrocyanic Acid, Cyanides, Cyanates, Thiocyanates, Urea.

FEE FOR COURSES, £4 4s. (including Tutorial Class).

PRACTICAL CHEMISTRY.

Winter or Summer Session.

The Laboratory Course in Practical Chemistry (6 hours a week) may be taken either during the two winter terms or during the summer term. Students are, however, recommended to attend the Laboratory Course during the winter months.

Fee for the Course	(Winter Term),	£3	3	0
,,	(Summer Term),	2	2	0

The fee includes the use of a working table and of all the common reagents. For apparatus required, see p. 81.

ANATOMY.

PROFESSOR PATERSON.

Winter Session.

I. DESCRIPTIVE ANATOMY.

(*Daily, Saturdays excepted, at 12 Noon.*)

This Course, consisting of a hundred lectures, comprises a Systematic account of the Development, Relations, and Structure of the Organs composing the Human Body.

The Lectures will be illustrated by drawings, preparations, and recent dissections. In connection with the course, Demonstrations will be given from time to time of the naked-eye and microscopical structures described in the Lectures.

TEXT BOOKS—Turner's *Introduction to Anatomy.*
Quain's *Anatomy (ninth edition).*
Ward's *Osteology.*
Gray's *Anatomy.*

FEE—£3 3s.

II. PRACTICAL ANATOMY.

The Practical Course is under the immediate superintendence of the Professor; and special Demonstrations will be given from time to time in the Dissecting Room.

The Dissecting Room is open from 9 a.m. to 4 p.m. daily, except Saturday, when it is closed at noon.

TEXT BOOKS—Ellis's *Demonstrations of Anatomy (ninth edition).*
Cunningham's *Dissector's Guide.*
Cleland's *Directory for the Dissection of the Human Body.*

FEE, six months—£3 3s.; three months—£2 2s.

III. ANATOMICAL DEMONSTRATIONS.

(Mondays, Wednesdays, and Fridays, at 10 a.m.)

In this Course it is intended to describe, by demonstrations of recent dissections, the Topographical Anatomy of the Human Body. Special attention will be paid to superficial and sectional Anatomy, in their bearing on the practice of Medicine and Surgery.

FEE—£2 2s.; £1 1s. to Members of the Systematic or Practical Class.

IV. TUTORIAL CLASS.

(Tuesday and Thursday, 10 a.m.)

1. *A Tutorial Class for Junior Students* will be held during the first half of the winter session, in connection with the systematic course, in which Demonstrations of the Bones and Ligaments will be given.

No Fee is charged for this Class.

2. *A Tutorial Class for Senior Students* will be held during the second half of the winter session, in connection with the Practical Course. The object of this class is to assist Students who are preparing for Professional Examinations. They will be examined, both orally and by means of written papers, on the Bones and Ligaments, Regional Anatomy, and the Organs of Sense and central Nervous System.

FEE—£1 1s.; no Fee to Members of the Practical Class.

Summer Session.

I. PRACTICAL ANATOMY.

As in Winter.

FEE—£2 2s.

II. ANATOMICAL DEMONSTRATIONS.

Courses of Demonstrations on Regional Anatomy, and on the Nervous System and Organs of Sense will be given, at hours to be arranged.

FEE—£1 1s. No fee to members of the Practical Class.

III. TUTORIAL CLASS.

A Tutorial Class for Senior Students will be held as in winter, at hours to be arranged.

NOTE.—Special arrangements will be made for qualified Medical Men who purpose working at Anatomy or Pathology in this department.

ZOOLOGY.

PROFESSOR D'ARCY W. THOMPSON.

Courses in Zoology qualifying for Medical Degrees are provided both in the Winter and Summer Sessions. The Summer Course is instituted especially for Students who commence their medical studies in the Summer term.

In both Courses special attention is paid to the subjects prescribed for the First Professional Examination in the University of Edinburgh; and the Summer Course is more particularly restricted to these subjects. Both Courses include, in addition to Lectures, practical work and demonstrations in the Laboratory. See Appendix, p. 244.

I. WINTER SESSION.

Lecture Hours—Monday, Wednesday, and Friday, 11—12; Laboratory Class, 12—1.

The time available in the Winter Session permits this Course to extend over 60 Lectures. The first lectures deal with general biological problems:—The nature and properties of protoplasm; the physiology of cell-life; the structure and life-history of simple unicellular organisms.

FEE—£2 12s. 6d.

II. SUMMER SESSION.

Lecture Hours—Daily, 11—12; Laboratory Class, 12—1.

This Course consists of 50 Lectures, with practical work or demonstrations daily.

TEXT-BOOK.—Alleyne Nicholson's *Zoology* (Blackwood, 18s.).

FEE—£3 3s.

BOTANY.

Summer Session.

PROFESSOR GEDDES.

Daily, at 2 p.m. (except Saturday).

The full Syllabus of Lectures and Laboratory Practice, given at page 111, covers the course of instruction laid down for the First Professional Examination in the University of Edinburgh. See Appendix, p. 244.

FEE—£3 3s.

OPERATIVE SURGERY.

Summer Session.

DR MACEWAN.

Tuesday and Friday, at 4 p.m.

This Course is intended for Senior Students, Graduates, and others, who may be desirous of obtaining a practical

knowledge of Operative Surgery. It is suitable for the Army and Navy Entrance Examinations and for the examinations of the Universities and Royal Colleges of Surgeons.

Special facilities are given to those who desire to go through a Course of Surgical Operations within shorter periods during the Summer Session.

The Course includes :—

(1) Ligature of Arteries, Operations on Veins, Nerves, Tendons, and Bones.

(2) Excisions and Amputations.

(3) Surgery of Special Regions :—
  (*a*) Head and Face (including the Eye).
  (*b*) Respiratory Tract and Thorax.
  (*c*) Alimentary Tract and Abdomen.
  (*d*) Genito-Urinary System.

FEE—£2 2s.

DUNDEE ROYAL INFIRMARY.

FOUNDED 1793.

MEDICAL AND SURGICAL STAFF.

Honorary Consulting Physicians.

JAMES W. MILLER, M.D.
A. JAMES DUNCAN, M.D.
ROBERT SINCLAIR, M.D.

Honorary Consulting Surgeons.

DAVID GREIG, M.D., F.R.C.S. ED.
ALEXANDER CAMPBELL, M.D., F.R.C.S. ED.

Physicians.

JOHN B. MACLEOD, M.D.
A. M. STALKER, A.M., M.B.

Assistant Physician.

D. BEATTIE BAIN, M.D.

Aural Physician.

ROBERT SINCLAIR, M.D.

Surgeons.

DAVID MACEWAN, M.D.
D. STEELE MOON, L.R.C.S. ED.

Assistant Surgeon.

CHARLES TEMPLEMAN, M.B.

Ophthalmic Surgeon.

A. JAMES DUNCAN, M.D.

Dental Surgeon.

WALTER CAMPBELL, L.D.S.

Pathologist.

J. MACKIE WHYTE, M.A., M.B., M.R.C.S.

District Surgeons.

M. F. ANDERSON, M.B., C.M.
W. C. COWAN, L.R.C.P.S. ED.
D. BEATTIE BAIN, M.D.
JAMES K. LENNOX, L.F.P.S.G.

Medical Superintendent.

R. NEAVES M'COSH, M.A., M.D., M.R.C.P. ED.

Medical Assistants.

W. DOUGLAS ERSKINE, M.B.
J. CAMPBELL KYNOCH, M.B.

PROSPECTUS.

(Issued with the sanction of the Directors and Medical Staff of the Infirmary.)

SESSION 1889-90.

The Infirmary contains 250 beds, with an annual average number of over 2,000 in-patients, and an average daily residence of 150.

During the year 1887-1888 the in-patients were classified thus:—Medical, 1,006; Surgical, 727; Fever, 73; Total, 1,806. This number includes 347 children, for whose treatment there is a special Ward.

In addition to these, 3,790 patients attended the Infirmary Waiting-Room, and 5,893 were seen by the District Surgeons at their houses.

APPOINTMENTS.—Two qualified Resident Medical Assistants are appointed annually.

Clinical Clerks and Dressers will be attached to the Physicians and Surgeons. Students may also be appointed to assist in the *post-mortem* room.

GENERAL ARRANGEMENTS.—The Infirmary is open daily, for the purpose of Clinical Instruction, from 10 A.M. till 12.30 P.M.

Out-patients are seen in the Waiting-Room at 9 A.M. The Surgeons visit their Wards at 10 A.M.; the Physicians at 11 A.M.

Operations are performed in the Operating Theatre, at 10 A.M., and at such other times as may be necessary. The Ophthalmic Surgeon visits on MONDAY, WEDNESDAY, and FRIDAY, at 12 Noon; the Aural Physician on TUESDAY and FRIDAY, at the same hour.

Post-mortem examinations are made at 11 A.M.

Instruction in Practical Pharmacy and Dental Surgery is given in connection with the Dispensary Department.

FEES.—Fee for attendance on Hospital practice for one year, £2 2s.

Any further information may be had on application to the Medical Superintendent.

DUNDEE ROYAL ASYLUM.

ESTABLISHED 1820.

MEDICAL SUPERINTENDENT—JAMES RORIE, M.D.

The Asylum is within easy distance of Dundee, and has an average number of over 300 Resident Patients, and an annual average of 150 Recent Cases.

The Appointments include a Qualified Resident Assistant, and a Resident Clinical Clerk.

Clinical Instruction can be given at the Asylum at convenient hours.

Further information may be had on application to the Medical Superintendent.

TIME TABLE FOR DAY STUDENTS.

WINTER SESSION, 1889-90.

	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
A.M.						
9—10.	Int. Mathematics.	Jun. Mathematics. Chem. 2nd Course. (Metals.)	Int. Mathematics. Organic Chem.	Jun. Mathematics. Chem. 2nd Course. (Metals.)	Int. Mathematics. Chem. Tutorial Class (1).	Teachers' Math. Class. Analytical Chem. Teachers' Greek Class.
10—11.	Sen. Engineering. Chem. 1st Course.	Physics. Fine Art (10—1).	Sen. Engineering. Chem. 1st Course.	Physics. Logic.	Sen. Engineering. Chem. 1st Course. Chem. Tut. Class (2)	Teachers' Latin Class. Teachers' French Class.
	Anatomical Demonstrations.	Anatomical Tutorial.	Anatomical Demonstrations.	Anatomical Tutorial.	Anatomical Demonstrations. Fine Art (10—1).	
11—12.	Biology. Tutorial Math.	Mechanics. Senior Greek.	Biology. Tutorial Math.	Mechanics. Senior Greek. Elec. Engineering.	Biology. Senior Greek. Jun. Engineering.	Eng. Language.
P.M.						
12—1.	Junior Latin. Descriptive Anatomy.	Jun. Engineering. Senior Latin. Descriptive Anatomy.	Junior Latin. Descriptive Anatomy.	Jun. Engineering. Senior Latin. Descriptive Anatomy.	Junior Latin. Senior Latin. Descriptive Anatomy.	Anglo-Saxon.
1.30—2.30.	Junior Drawing Lecture.		Senior Drawing Lecture.			
2—3.	Junior Greek.		Junior Greek.		Junior Greek.	
3—4.		French.	London Exam. Class.	Modern History.	French.	
4—5.	Eng. Literature.	German.	Eng. Literature. Greek Poetry.	Eng. Composition.	Eng. Literature. German.	
7—8.				Dyeing.		

The Physical and Mechanical Laboratories are open daily (except Saturday) from 10 to 4.
The Chemical Laboratory and Dyehouse are open daily from 9 to 4, except on Saturday, when the Laboratory closes at 3, and the Dyehouse at 1.
The Engineering Laboratory is open daily, except on Saturday, from 10 to 4.30; the Electrical Engineering Laboratory is open on Tuesday, Thursday, and Friday, and to advanced Students every day.
The Drawing Office is open daily (except Saturday) from 10 to 4.30.
The Biological Laboratory is open daily from 9 to 4.
The Anatomy Rooms are open daily from 9 to 4, except Saturdays, when they are closed at noon.

TIME TABLE FOR DAY STUDENTS.

SUMMER SESSION, 1889-90.

	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
A.M. 9—10.	Sen. Mathematics. Graphic Statics (Engineering).	Jun. Mathematics.	Sen. Mathematics. Graphic Statics (Engineering).	Jun. Mathematics.	Sen. Mathematics. Graphic Statics (Engineering).	Analytical Chem.
		Chem. 2nd Course. (Organic.)	Chem. 2nd Course. (Organic.)	Chem. 2nd Course. (Organic.)		
10—11.	Chem. 1st Course. Sen. Engineering.	Physics. Anatomical Tut. Fine Art (10—1).	Chem. 1st Course. Sen. Engineering.	Physics. Anatomical Tutorial.	Chem. 1st Course. Sen. Engineering. Fine Art (10—1).	Botany—Teachers' Class (10—1).
11—12.	Zoology. Embryology. Tutorial Math.	Zoology. Mechanics. Senior Greek.	Zoology. Embryology. Tutorial Math.	Zoology. Mechanics. Senior Greek.	Zoology. Embryology. Senior Greek.	Eng. Language.
P.M. 12—1.	Junior Latin.	Senior Latin.	Junior Latin.	Senior Latin.	Junior Latin. Senior Latin.	Anglo-Saxon.
	Anatomical Demonstrations.		Anatomical Demonstrations.		Anatomical Demonstrations.	
1.30—2.30.	Junior Drawing Lecture.		Senior Drawing Lecture.			
2—3.	Junior Greek. Botany.	Botany.	Junior Greek. Botany.	Botany.	Junior Greek. Botany.	
3—4.		French.	London Exam. Class.	Modern History.	French.	
4—5.	Eng. Literature.	German.	Eng. Literature.	Eng. Composition.	Eng. Literature. German.	
		Operative Surgery.			Operative Surgery.	

The Physical and Mechanical Laboratories are open daily (except Saturday) from 10 to 4.
The Chemical Laboratory and Dyehouse are open daily from 9 to 4, except on Saturday, when the Laboratory closes at 3, and the Dyehouse at 1.
The Engineering Laboratory is open daily, except on Saturday, from 10 to 4.30; the Electrical Engineering Laboratory is open on Tuesday, Thursday, and Friday, and to advanced Students every day.
The Drawing Office is open daily (except on Saturday) from 10 to 4.30.
The Biological Laboratory is open daily from 9 to 4.
The Anatomy Rooms are open daily from 9 to 4, except on Saturdays, when they are closed at noon.
The Botanical Laboratory is open daily from 9 to 5.

Syllabus

OF THE

EVENING CLASSES.

THE EVENING CLASSES,

which will be conducted in relation to the Classes of the Technical Institute, are intended for those who, while unable to enter on a regular course of training during the day, are yet desirous of gaining a systematic knowledge of the subjects they elect to study. They meet during the Winter Session only.

Students will be enrolled on Friday, the 4th, and Saturday, the 5th of October, from 7 to 9 P.M. Further attendance will be given for the purpose of enrolment during the first week of the Winter Session.

Examinations of all the Classes will be held at the end of the Session, and the Prizes and Certificates awarded to distinguished Students will be distributed at the Annual Meeting held at the close of the Academic year.

MATHEMATICS AND NATURAL PHILOSOPHY

PROFESSOR STEGGALL AND MR M'COWAN

The Classes in this department are of two kinds, Lectures and Laboratory Practice. They will be found to supplement the allied classes in the Technical Institute in the manner shewn below. The general heads are

I. Mathematics.
II. Natural Philosophy—Lecture Work.
III. Laboratory work in Mechanics, Light, Heat, Magnetism, and Electricity.

I. MATHEMATICS

FIRST COURSE.—Arithmetic, Geometry, and Algebra adapted to the requirements of Stage I. of the Science and Art Examinations (see Syllabus of Technical Institute).

SECOND COURSE.—Geometry, Trigonometry, and Algebra adapted to the requirements of Stage II. of the Science and Art Examinations (see Syllabus of Technical Institute).

THIRD COURSE—*Tuesday, 7—8.*—The work taken up will be decided upon at the first meeting of the class. It will consist of such of the following portions of the subject as may be found most desirable :—

1. Algebra from quadratic equations.
2. Trigonometry to solution of triangles.
3. Elements of the Theory of Equations.
4. Elements of co-ordinate Geometry.
5. Analytical Trigonometry.
6. Geometrical Conic Sections.
7. Solid Geometry, *e.g.*, Euclid, Book xi.

It will probably be found that this class will be so arranged as to cover the work required for either Stage III. or Stage IV. at South Kensington.

FEE—7s. 6d.

II. NATURAL PHILOSOPHY LECTURES

(A) MECHANICS

In the Institute two courses will be offered, adapted respectively to the requirements of the Elementary and Advanced Stages of the Science and Art Examinations (see Syllabus of Technical Institute).

In the College a course will be offered on GRAPHIC ARITHMETIC AND STATICS, under the following heads (subject to Postscript, p. 73) :—

1. Application of geometrical methods to the representation of arithmetical quantities, as sums, differences, products, quotients, powers, and roots : the equiangular spiral and its applications.

2. Application of geometrical methods to problems involving mass, area, volume.

3. Application of geometrical methods to statical problems, as in the polygon of forces, reciprocal figures, centres of gravity, distribution of stress, moments of inertia ; and to dynamical problems, such as the representation of velocity, acceleration, energy, momentum.

TEXT BOOK—Gray & Lowson's *Graphical Statics.*

FEE—7s. 6d.

(B) PHYSICS

SOUND, LIGHT AND HEAT.—Two classes will also be offered in these allied subjects. They will be adapted to the Elementary and Advanced Stages of the Science and Art Examinations (see Syllabus of Technical Institute).

ELECTRICITY AND MAGNETISM.—Two classes of a similar character may be offered in this group (see Syllabus of Technical Institute).

An advanced class may also be offered if a sufficient number of students present themselves; it will be given on Tuesday evenings from 8 to 9. See also page 73.

FEE—7s. 6d.

III. LABORATORY WORK

There are two distinct branches of practical work for which accommodation and appliances are provided; and students are recommended to confine their attention mainly to one, viz., either to the Mechanical division or the Physical division. The first includes Mechanics, Properties of Matter, Optics, and Heat; the second includes Light, Electricity, and Magnetism.

MECHANICAL DIVISION

The Mechanical Laboratory in the Technical Institute will be available for college students; and in it will be performed experiments and measurements on the mechanical side of Natural Philosophy.

The equipment includes apparatus for the exact measurement of simple quantities such as length, area, volume, mass; and experiments have been arranged to bring students into practical contact with the estimation of velocity, acceleration, force, momentum, energy, and work. The manner in which these measurements will be made is intended to be both useful in practice, and scientific in principle. Thus the laws of elasticity, of torsion, of friction will be investigated by various methods, and the principles of elementary statics and kinetics will be studied with suitable apparatus.

The conversion of energy of motion into work, and *vice-versâ*, and the effect on internal stress of rapid rotation have been specially considered in the equipment.

There is also a tank, twenty-five feet long, which is intended to be used in experimental work connected with fluid motion and resistance, wave motion, vortex motion, and other hydrodynamic phenomena.

It is expected that this part of the work will be of value to students who have occasion to study the principles of ship construction.

There are special arrangements also for experiments in heat: expansion-coefficients, specific heat, conductivity, latent heat will be treated in this laboratory from as practical a point of view as possible.

PHYSICAL DIVISION

In the Physical Laboratory, attendance at which is recommended to all students of Physics, the work will be adapted as far as possible to the attainments of those who attend. Thus students with little previous knowledge may wish to repeat for themselves some of the lecture experiments they have seen, or to modify them in a manner that renders measurement more certain: others will wish to avail themselves of the opportunities offered for using and examining the apparatus used for practical work in the laboratory: while for students with some experience ample facilities will be afforded for carrying out investigations that require very careful manipulation, or for repeating classical measurements of physical constants with as much accuracy as possible.

The general nature of the course in this division is given in sections 6 to 20 in the schedule on page 68.

Special attention is given to practical electrical measure-

ments, of which an elementary and an advanced syllabus have been drawn up.

Students are advised to attend the laboratories, when possible, for two years, giving the first year to the mechanical division, and the second to the more purely physical division, and to this end a course has been arranged which can be carried out with two years' attendance.

The Mechanical and Physical Laboratories are always open on Wednesday evenings, and advanced students may sometimes attend on other evenings, if convenient arrangements can be made.

TEXT-BOOKS recommended. — Kohlrausch's *Physical Measurements;* Stewart & Gee's *Practical Physics;* Glazebrook & Shaw's *Practical Physics;* Perry's *Practical Mechanics.*

FEE for three hours a week, £1 1s.

CHEMISTRY.

PROFESSOR PERCY FRANKLAND AND DR THOMSON.

SPECIAL COURSE OF 50 LECTURES ON INORGANIC CHEMISTRY

By PROFESSOR PERCY FRANKLAND.

Monday and Thursday during the Winter Terms; Thursday during the Summer Term.

The General Principles of Inorganic Chemistry, the properties of the more important Elements and Compounds, with special reference to their technical applications.

This Course will not be repeated for several Sessions to come, and it is therefore very desirable that all students attending the Evening Classes should avail themselves of this introduction to the study of Chemistry.

FEE FOR THE COURSE—£1 5s.

This class will only be formed if a sufficient number of students come forward.

ORGANIC CHEMISTRY.

DR THOMSON.

Lecture Hour—Monday, 6—7.

This Course (which is also intended to be preparatory to the Courses of Lectures on Dyeing and on the Chemistry of the Jute, Flax, and other Fibres), will include:—The

Analysis, Constitution, and Classification of Carbon Compounds. The relations of the best defined groups of Organic bodies, and the laws regulating their formation. It will also treat of Fats, Oils, Sugars, Starches, Cellulose, Coal Tar, Colours, &c.

TEXT-BOOK.—Remsen's *Text-Book of Organic Chemistry* (Macmillan).

FEE—7s. 6d.

PRACTICAL CHEMISTRY (Laboratory).

The Laboratory is fitted up with every convenience for instruction in all branches of Chemical Analysis, and each Student works independently of the others.

Working Hours—Monday and Thursday, 6—10 p.m.

FEE for four hours per week, £1 10s., and for every additional hour, 5s.; for Students joining at Christmas, 17s. 6d. for four hours per week, and 3s. for every additional hour.

A deposit of 1s. will be required from each Student on the receipt of the key of his working table. This will be refunded when the key is returned.

For further information as regards Apparatus, &c., see page 81. The cost of a Set of Apparatus will be about 21s.

DYEING, BLEACHING, and the CHEMISTRY of the TEXTILE FIBRES.

The following Course of Study, extending over four years, is recommended for those who are, or who intend to become, dyers or bleachers; whilst the Classes in Theo-

retical and Practical Chemistry, and the Chemistry of Jute, Flax, and other Fibres, are also suitable for those who are interested in the textile manufactures.

FIRST YEAR.

Chemistry Lectures, 1st Course (Inorganic)—5s.
Chemical Laboratory, (Qualitative Analysis) } 30s.
Machine Drawing—15s.

SECOND YEAR.

Chemistry Lectures (Organic)—7s. 6d.
Lectures on Chemistry of Jute, Flax, &c.—7s. 6d.
Chemical Laboratory, (Analysis of Materials used in Dyeing and Bleaching) } 30s.

THIRD YEAR.

Lectures on Dyeing and Bleaching—7s. 6d.
Practical Work in the Dyehouse—30s.

FOURTH YEAR.

Lectures on Dyeing and Bleaching—7s. 6d.
Practical Work in the Dyehouse—30s.

LECTURE COURSES.

PROFESSOR PERCY FRANKLAND.

First Course—CHEMISTRY OF THE TEXTILE FIBRES, BLEACHING.

This Class, which should be taken if possible before the Course on Dyeing, or a general Course on Spinning and Weaving, will treat of the following heads:—Cellulose and its relation to the Vegetable Fibres. Classification of Fibres, and their chief points of difference. General characters of

Cotton, Flax, Jute, Hemp, China Grass, and Wool, including an account of their origin, culture, chemical properties, action of chemical agents, preparation of the raw material for spinning and weaving, affinity for colouring matters, &c. Bleaching, Sizing, Finishing, and other cognate subjects, so far as time will permit.

FEE—7s. 6d.

Second Course—THE CHEMISTRY OF DYEING (Natural Colouring Matters).

Lecture Hour—Thursday, 7—8 p.m.

This Course will treat of the Theory of Dyeing and the affinity of the several textile fibres for colouring matters; the nature and use of Mordants; the origin, nature, and properties of the more important Natural Colouring Matters, together with the methods of applying them to the textile fibres. (For full Syllabus, see p. 87).

The Course will be found useful not only to those engaged in dyeing operations, but also to all whose occupation involves the handling of dyed materials.

FEE FOR THE COURSE—7s. 6d.

Third Course—DYEING (Artificial Colouring Matters).

The Second Course only will be given during the present Session.

PRACTICAL WORK IN THE DYEHOUSE.

Working Hours—Monday and Thursday, 6 to 10 p.m.

FEE—For four hours a-week, 30s., and 5s. for each additional hour.

A deposit of 1s. will be required from each Student on the receipt of the key of his working table; this will be refunded when the key is returned. The above fees include

the use of a work-table, dye-vessels, steam, gas, dyes, mordants, and other chemicals, but each Student must provide himself with the following set of Apparatus :— (1) Six Porcelain Basins, (2) Two Glass Rods, (3) Cleaning Stick, (4) Large Porcelain Basin, (5) Bone Spatula, (6) Towel, (7) Box of Weights, (8) Sample Book. The cost of the set will be about 17s. A small charge will also be made for the Cloth and Yarn used for the experiments.

During the first year in the Dyehouse the Student will study the dyeing properties of the natural colouring matters; and during the second year the properties and methods of dyeing with coal tar colours.

Students taking the Courses on the Textile Fibres, and on Dyeing and Bleaching, will be expected to make good use of the Technical Museum, concerning which see page 90.

TIME TABLE OF EVENING CLASSES IN THE CHEMICAL AND DYEING DEPARTMENTS.

MONDAY.	THURSDAY.
P.M.	P.M.
6—7. Organic Chemistry.	7—8. Dyeing.
9—10. Inorganic Chemistry.	9—10. Inorganic Chemistry.

ENGINEERING.

PROFESSOR EWING.

ASSISTANT AND LECTURER ON DRAWING—THOMAS REID.

The Evening Classes in the Engineering Department of the College are designed to supplement those held in the Technical Institute on

Applied Mechanics.
Steam.
Practical Geometry.
Building Construction.
Machine Construction and Drawing, and
Mechanical Engineering and Engineering Drawing (adapted to the Syllabus of the City and Guilds of London Institute).

Particulars of these Classses will be found in the Syllabus of the Technical Institute.

The following more Advanced Courses will be given by the College:—

I. Lecture course on the Steam Engine and other Heat Engines. (Prof. EWING.)

II. Practical Laboratory Class (in the new Engineering Laboratory in the Technical Institute). (Prof. EWING.)

III. Drawing—with special reference to the Design of Steam Engines and Boilers. (Mr REID.)

I. STEAM ENGINE.

Lecture Hour—Monday, 8—9 p.m.

Historical development of the Steam Engine. Sketch of the theory of heat engines. Properties of perfect gases. Properties of steam. Action of steam in the cylinder. In-

dicator diagrams. Use of the indicator. Efficiency of Steam Engines. Methods of testing efficiency. Influence of speed, of jackets, of compounding, &c. Condensation and re-evaporation of steam in the cylinder. Compound Engines: double, triple, and quadruple. Use of intermediate receiver. Compound indicator diagrams. Production of steam. Distribution of steam. Valves and valve motion. Zeuner's diagram. Expansion valves. Link motion. Corliss gear. Governors. Fly wheels. Diagrams of crank effort. Fluctuation of speed. Types of Steam Engines—stationary, marine, and locomotive. Compound locomotives. Types of boilers. Gas engines. Hot air engines.

It is recommended that this Course be taken along with Course II. below.

TEXT-BOOK—Professor Ewing's Article, *Steam Engines*, in the *Encyclopædia Britannica*.

FEE—7s. 6d.

II. ENGINEERING LABORATORY.

Wednesday, 7.30—9.30.

In the new Engineering Laboratory, which is furnished with a compound steam engine specially designed for experimental work, a gas engine, a 50-ton testing machine, and many other pieces of apparatus, the students will conduct experiments with the steam engine and gas engine on the taking of indicator diagrams, and calculating the power; on measuring power by brake and rope dynamometers; measuring heat supplied and heat rejected, and finding the efficiency of the engine; testing the accuracy of pressure gauges and indicators; testing experimentally the comparative effects of simple and compound expansion, the comparative effects of different speed, the influence of the

steam jacket, and of other variable conditions. The steam engine is arranged for use either without condensation or with surface or jet condensation: the speed of the engine and the capacity of the receiver may be varied; the cylinder may be used separately or compounded; the cranks may be uncoupled or coupled at various angles, &c., &c. The testing machine allows tests of materials to be made on the same scale as that used in steel works by Lloyds' Surveyors, the Board of Trade, &c. The machine is adapted to test in tension, compression, bending, and shearing, and to draw autographic diagrams showing the relation of the yielding of the material to the applied load. The Laboratory is also furnished with minor appliances for tests of wire, cement, &c., and for examination of the elasticity of bodies when subjected to tension, bending, and torsion. Experiments in all these subjects (so far as time will permit) are conducted by the students themselves, under the direction of the Professor.

It is recommended that this Course be taken along with Course I. above.

FEE—15s.

III. ENGINEERING DRAWING.

Tuesday and Friday, 7—10 p.m.

Lecture Hour, 7.30—8.30 p.m.

This Class is intended for Students who, by attendance on Government Science Classes or otherwise, have already obtained an elementary general knowledge of Engineering Drawing.

A course of Lectures, with Black-board demonstrations, will be given on the considerations involved in the Design of Steam Engines and Boilers, with reference to the

dimensions of their parts. A special example in each case will be taken; the separate parts of which will be considered in detail, their dimensions calculated, and working drawings prepared by the students.

Similar arrangements will be made for Civil Engineering students, who will be instructed in the Design of the Details of Roofs and Bridges.

Drawing-boards and T squares are furnished for the use of students. A limited number of sets of drawing instruments is also furnished, the use of which will be given to students not otherwise provided with instruments.

FEE—15s.

TIME TABLE OF EVENING CLASSES IN THE ENGINEERING DEPARTMENT.

MONDAY.	TUESDAY.	WEDNESDAY	FRIDAY.
Steam Engine, (Lecture by (Prof. EWING) 8—9.	Drawing, 7—10. (Mr REID).	Engineering Laboratory, 7.30—9.30. (Prof. EWING)	Drawing, 7—10. (Mr REID).

BIOLOGY.

PROFESSOR D'ARCY W. THOMPSON.

PHYSIOLOGY.

Lecture Hours—Monday and Tuesday Evenings, from 7—8.

During the WINTER SESSION 1889-90, a Course of Lectures will be delivered on Elementary Physiology. In the first half of the Winter Session the subjects dealt with will include—Muscle and Nerve, the Blood and the Circulation, and Respiration; during the second term Digestion and Nutrition and the Nervous System will be treated. The Lectures will be illustrated as fully as possible by experiment, and practical demonstrations will be provided in the Laboratory.

This Course is specially destined for Teachers, and is such as to qualify for Honours in the St Andrews L.L.A. Examination.

TEXT-BOOKS.—Huxley's *Elementary Physiology* (Macmillan, 4s. 6d.), or Foster's *Physiology* (Macmillan, 21s.)

FEE—10s. 6d.

BOTANY.

PROFESSOR GEDDES.

A Course of one Lecture weekly during the Summer Term will be given. In 1890 the Course will be entitled, "Evolution in Plants," and will include a general statement and discussion of the theory of Evolution as illustrated by the vegetable world. No previous knowledge is required. The Class will meet on Fridays, at 8 P.M., beginning Friday, 18th April. Students may attend the Botanical Excursions. See pp. 111—114.

As far as possible, assistance in pursuing Botanical studies during the vacation will again be given.

FEE—5s.

CLASSICS AND ANCIENT HISTORY.

PRINCIPAL PETERSON.

Assistant Lecturer—GILBERT ELLIOT, B.A.

The Authors to be read in the Language Classes will be chosen with reference to the wants of the Students who present themselves. Opportunity will be given of preparing, as far as possible, for special Examinations, such as the Preliminary Examination in Science of St Andrews University, the Matriculation Examination of the University of London,* and the Examination in General Knowledge under the Law Agents' Act. Besides the work done in the class, Students will be expected to prepare a prescribed portion of Greek and Roman History, in illustration of which occasional Lectures will be delivered by the Principal.

*The Books prescribed for the London University Matriculation Examination in June 1890 are Cicero, de Amicitia, pro Balbo: Xenophon, Hellenics, Book ii.

GREEK.

Tuesday and Friday, 7—8 p.m.

The work of this Class will include instruction in Grammar and Elementary Composition. The reading selected will be from any book which the members of the Class may wish to study; and the Text-book to be used will be chosen when the Class is formed. An elementary knowledge of Greek Accidence will be expected upon entrance. This may be obtained from Rutherford's *First Greek Grammar*, or Abbott & Mansfield's *Elementary Greek Grammar*.

FEE—15s.

JUNIOR LATIN.

Tuesday and Friday, 8—9 p.m.

This Class will meet for exercise in Latin prose composition, and for the translation of select portions of Latin authors, such as those contained in Macmillan's series of "Elementary Classics," *e.g.*, Ovid (Selections), Cornelius Nepos, or Eutropius. Provision will also be made, if desired, for the study of the First Book of Cæsar, which is prescribed for so many examinations. A knowledge of the outlines of Latin Accidence and Syntax will be expected on entrance, such as may be obtained from Bennett's *First Latin Writer* or Abbott's *Via Latina.*

FEE—15s.

SENIOR LATIN.

Wednesday and Friday, 9—10 p.m.

This Class will meet in two sections (1) for the reading and exposition of selected portions of more advanced authors, such as Virgil, Horace, and Cicero; and (2) for the practice of Latin Prose Composition and Translation. Students will be allowed to join either section, though they are strongly recommended to enter for both.

In each Class, exercises will be prescribed for translation from Latin into English.

TEXT-BOOK.—Bennett's *Easy Graduated Latin Passages* (Rivingtons).

FEE—15s. FEE FOR EACH SECTION—7s. 6d.

ROMAN HISTORY.

Wednesday, 8—9 p.m.

During the First Part of the WINTER SESSION the Principal will deliver a Popular Course of Nine Lectures on the History of Rome during the last century of the Republic. The following is a synopsis of the Course:—Introductory sketch of previous history. The Gracchi and the Land Question. The Rival Orders. Marius and the Army. The Struggle for the Franchise. Sulla and his oligarchical constitution. The Reaction: Pompey, Cicero, Catiline. The Great Civil War. Caesar's Legislation and Death. The Republic becomes an Empire.

The Introductory Lecture, on the "Interest of Roman History," will be open to the public.

FEE—5s.

LOGIC.

Lecturer—GILBERT ELLIOT, B.A., late Scholar of Lincoln College, Oxford.

The Course on Logic will be repeated in the evening if a sufficient number of Students offer. The following is a synopsis of the Course:—Scope and definition of Logic. Terms—their various kinds. The import and various kinds of Propositions. Opposition and conversion of Propositions, and Immediate Inference. The Predicables, Division and Definition. The Syllogism, its Moods and Figures. Reduction of the Imperfect Figures. Fallacies. Induction, Perfect and Scientific. Observation and Experiment, and the Methods. Hypothesis, Geometrical and Mathematical Induction, and Analogy.

TEXT-BOOK.—Jevons' *Lessons in Logic* (Macmillan).

FEE—10s. 6d.

ARTISTIC ANATOMY.

PROFESSOR PATERSON.

A Course of Twelve Lectures will be given on Tuesday Evenings during the first term, commencing on Oct. 7th, at 8 p.m.

These Lectures will deal with the Anatomy of the Human Form from an artistic point of view. A description will be given of the bones, joints, and muscles: their form and connexions; and of the mechanism of the several parts.

The Anatomy of expression will also be treated of, including the various movements of the body, the expressions of the face, the shape of the head in different races, and the changes which occur to produce the different forms characteristic of age and sex.

ENGLISH LANGUAGE & LITERATURE AND MODERN HISTORY.

PROFESSOR GILRAY.

I. ENGLISH LITERATURE.

Mondays and Thursdays, 8—9 p.m.

The work of this Class will consist of a course of Twenty Lectures on Shakespeare and the Elizabethan Age.

One meeting each week will be devoted to the study of an English Classic. The Books proposed for Session 1889-90 are Shakespeare's "Midsummer Night's Dream" and "Hamlet."

The Students will be expected to give in to the Professor Essays on prescribed subjects. These will be carefully corrected, valued, and returned.

TEXT-BOOKS. — Shakespeare's "Midsummer Night's Dream" (Clarendon Press) and "Hamlet" (Clarendon Press)

FEE—15s.

II. MODERN HISTORY.

Mondays, 7—8 p.m.

The Professor will deliver a Course of Nine Lectures, during the first term, on the History of the French Revolution. The Course will aim at presenting, in a popular form, the best results reached by the leading French and English authorities.

FEE—5s.

III. ENGLISH COMPOSITION & RHETORIC.

Mondays and Thursdays, 9—10 p.m.

The work of this Class is arranged as follows. (1) Opportunities will be given weekly for Practice in English Composition. The exercises written in the Class-room will be examined by the Professor, carefully corrected, valued, and returned. In returning the papers, the Professor will make such remarks as he thinks may be useful to the Students individually and to the Class as a whole.

(2) More lengthy Essays to be done at home, and to be given in at stated intervals.

(3) The Professor will read extracts from the greatest Masters of English Prose in illustration of the different Qualities of Style, and will aim at cultivating a sense of style and purity of taste in the Students.

(4) A systematic study of the Rules of Correct Writing, and the Principles of Rhetoric and Literature. Under this head a Course of Lectures will be delivered in expansion and illustration of the matter supplied by the Text-Book.

TEXT-BOOK.—Bain's *English Composition and Rhetoric* (Longmans, Green, & Co.).*

FEE—15s.

N.B.—The edition used is the one published complete in one volume at 4s.

FRENCH.

LECTURER—M. H. DURLAC.

Attendance at one or other of the Evening French Classes is recommended to all Students preparing for the Matriculation Examination of the University of London.

JUNIOR CLASS.

Monday and Thursday, 8—9 p.m.

Reading; Grammar; Exercises; Translation of Prose and Poetry into English; Translations into French; Conversation.

TEXT-BOOKS.—Fivas' *Grammar;* Soulice, *Premières connaissances;* Pressard, *Exercices de Récitation et de Lecture* (Hachette, Paris).

Dictionary recommended: Gustave Masson (Macmillan & Co.).

FEE—15s.

SENIOR CLASS.

Monday and Thursday, 8—9 p.m.

Reading; Grammar; Exercises; Translation of French Prose and Poetry into English; French Composition; Commercial Correspondence; Recitation; Conversation.

TEXT-BOOKS.—Fivas' *Grammar;* Soulice, *Premières connaissances;* Pressard, *Exercices de Récitation et de Lecture* (Hachette & Cie, Paris); Bertrand, *Correspondance commerciale.* For French Composition—Kastner, *Elements of French Composition* (Hachette & Cie).

FEE—15s.

GERMAN.

LECTURER—M. H. DURLAC.

Monday and Thusday, 7—8 p.m.

The Class will be conducted in such a way as to enable Students of different grades to attend it. The work will comprise :—Reading — Grammar — Exercises — Translation from German Prose and Poetry into English—German Composition—Commercial Correspondence—Conversation—Recitation.

TEXT-BOOKS.—Naftel, *German Grammar, 1st part*, Accidence, for revision ; *2nd part, Syntax* and *Book of Exercises on the Syntax ;* Havet, Schrumpf and Becker, *German Composition ;* Hauff, *Die Karawane ;* Schiller, *Wallenstein's Lager ;* Asher, by Vogel, *German Correspondence.* Literature, Texts-book recommended: Hermann Kluge, *Deutsche National-Litteratur.*

Dictionary recommended: Koehler.

FEE—15s.

TIME TABLE OF THE EVENING CLASSES.

FOR OTHER CLASSES, SEE SYLLABUS OF TECHNICAL INSTITUTE.

	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.
6—7.	Organic Chemistry.				
7—8.	Mathematics. Physiology. Modern History. German.	Physiology. Greek.	Graphic Statics.*	German. Dyeing.	Greek.
8—9.	Physics.* Steam Engine. English Literature. French.	Junior Latin. Artistic Anatomy (first term).	Roman History (first term).	English Literature. French.	Junior Latin. Botany (Summer Term).
9—10.	English Composition. Inorganic Chemistry.		Senior Latin.	English Composition. Inorganic Chemistry.	Senior Latin.

The Physical and Mechanical Laboratories will be open on Wednesday evenings.
The Chemical Laboratory and the Dyehouse will be open on Monday and Thursday evenings, from 6 to 10.
The Engineering Laboratory will be open on Wednesday evenings, from 7.30 to 9.30.
Engineering Drawing will be taught on Tuesday and Friday evenings, from 7 to 10.

*For details concerning the arrangements for the Classes in Physics, see Postscript, p. 73.

Appendix.

THE PRINCIPAL'S REPORT FOR SESSION 1888-89.

The Sixth Session of the College began on Monday, 8th October, the Entrance and Scholarship Examinations having been held in the previous week. On the evening of Saturday the 6th, the usual Introductory Address was delivered in the College Hall by Professor Ewing, who took for his subject the progress of Science Education in Dundee during the last twenty years.

The total number of Day Students during the Session has been 168, as against 127 last year. An analysis of the entries shows that this gratifying advance is pretty evenly distributed over the several years of the curriculum: of first year's students we have had 70, as against 60 last session; of second year's students 39, as against 30; of third year's 30, as against 17; and of fourth year's 14, as against 10. Last session I had to record a falling off in the number of Women Students: this year it has again gone up, there having been 59 women in attendance on our Day Classes, as against 36 last year. The number of registered Male Students continues steadily to increase, being greater this year (109) than in any previous session of the College.

The total number of Evening Students is 199, as against 170 last year. When it is remembered that the opening of the Technical Institute has naturally diminished the attendance on our more elementary Classes, and has in some cases done away with these classes altogether, this advance in numbers must be regarded as doubly satisfactory. The

number of first year students in the Evening Department is also larger than it was last Session (113, as against 94); and the same increase as was noted in regard to the Day Classes has taken place in the number of second and third year's students. The proportion of women to men in the Evening Classes has, however, this year been remarkably small.

It may be interesting to compare the following Tables, which will show at a glance how much reason we have to be satisfied with the results of the past session :—

NUMBER OF STUDENTS.

	1887-88.			1888-89.		
	Men.	Women.	Total.	Men.	Women.	Total.
Day Students, -	91	36	127	109	59	168
Evening Students,	135	35	170	189	10	199
	226	71	297	298	69	367

As the number of students in attendance at the Technical Institute is now fully 350, it may be asserted (making allowance for cases of double entry) that nearly 700 individuals are taking advantage of the facilities which the College and the Institute together afford for the prosecution of study.

NUMBER OF FIRST, SECOND, THIRD, FOURTH, AND FIFTH YEAR'S STUDENTS.

	1887-1888.			1888-1889.		
	Day.	Evening.	Total.	Day.	Evening.	Total.
First Year's Students,	60	94	154	70	113	183
Second ,,	30	40	70	39	45	84
Third ,,	17	18	35	30	24	54
Fourth ,,	10	10	20	14	8	22
Fifth ,,	10	8	18	10	4	14

The slight falling off in the last line of this table is more than counterbalanced by the fact that ten of our original

students have been so appreciative as to continue their work into this, the *sixth* year of our collegiate existence.

A careful analysis of the gross entries shows that a very satisfactory proportion of the students continue to take more or less complete and connected courses of study.

Subjoined is a statement of the numbers of individual Students in the different departments, and of the entries in the various classes. For the purpose of comparison, the corresponding numbers last year are also given.

NUMBER OF STUDENTS IN THE DIFFERENT DEPARTMENTS.

	1887-88.			1888-89.		
	Day.	Evening.	Total.	Day.	Evening.	Total.
Mathematics and Natural Philosophy,	47	14	62	47	27	74
Chemistry,	52	45	97	56	35	91
Dyeing and Bleaching,	—	—	—	—	70	70
Engineering and Drawing,	19	33	51*	24	33	57
Biology and Botany,	35	60	95†	—	—	—
Biology,	—	—	—	25	12	37
Botany,	—	—	—	33	18	51
Anatomy,	—	—	—	14	10	24
Classics and Ancient History,	26	23	49	32	17	49
English Language and Literature and Modern History,	18	48	66	16	29	45
French,	10	9	19	8	11	19
German,	—	9	9	6	9	15
Fine Art,	—	—	—	7	—	7

* Exclusive of largely attended Lecture Courses on Electric Lighting and Domestic Drainage.

† Including Mr Geddes's Classes.

ENTRIES IN DAY CLASSES.

MATHEMATICS—	1887-88.	1888-89.
Junior,	13	17
Intermediate,	13	6
Senior,	1	3
Tutorial,	24	19
Saturday Class for Teachers,	—	1

	1887-88.	1888-89.
NATURAL PHILOSOPHY—		
Mechanics,	17	14
Experimental Physics,	17	15
Mathematical Physics,	1	1
Physical Laboratory,	20	15
CHEMISTRY—		
First Year's Course,	14	24
Second Year's Course,	10	8
Tutorial Class,	20	17
Analytical Chemistry,	9	9
Chemical Laboratory,	48	46
ENGINEERING AND DRAWING—		
Engineering (Lecture Course),	11 Jun. 7 Sen.	13 —
Surveying and Levelling,	5	7
Engineering Laboratory,	11	8
Electrical Engineering,	1	—
Do. Laboratory,	4	3
Drawing,	7 Jun. 4 Sen.	11
BIOLOGY—		
Elementary Biology and Zoology,	14	15
Summer Course,	—	2
Advanced Biology,	—	3
Comparative Embryology,	4	4
Biological Laboratory,	7	21
BOTANY,	21	17
Teachers' Class,	—	16
ANATOMY—		
Descriptive Anatomy,	—	5
Practical do.,	—	11
Tutorial do.,	—	6
Operative Surgery,	—	2

	1887-88.	1888-89.
CLASSICS AND ANCIENT HISTORY—		
Junior Greek,	6	3
Senior Greek,	2	3
Saturday Class for Teachers,	2	4
Junior Latin,	7	8
Senior Latin,	3	6
Saturday Class for Teachers,	4	—
Roman History, &c.,	13	11
LOGIC,	—	11
ENGLISH LANGUAGE AND LITERATURE AND MODERN HISTORY—		
English Literature,	7	1
English Language,	5	6
Modern History,	4	4
English Composition and Rhetoric,	4	11
Anglo-Saxon, or Old English,	3	2
London University Class,	2	2
FRENCH—		
Afternoon Class,	6	5
Saturday Class for Teachers,	5	3
GERMAN,	—	
FINE ART,	—	7

ENTRIES IN EVENING CLASSES.

		1887-88.	1888-89.
MATHEMATICS—			
Junior Class,	1 Sec.	6	6
	2 Sec.		
Senior Class,		1	1
NATURAL PHILOSOPHY—			
General Physics,		1	1
Physical Laboratory,		4	10
Popular Course,		7	10

	1887-88.	1888-89.
CHEMISTRY—		
Metals,	11	—
Organic Chemistry,	10	10
Laboratory,	16	17
Analytical,	—	11
Dyeing and Bleaching (Lectures),	—	70
Do. (Practical),	—	7
ENGINEERING AND DRAWING—		
Steam Engine,	12	—
Strength of Materials,	—	21
Laboratory,	—	16
Drawing,	21	11
BIOLOGY—		
General Biology,	6	—
Physiology,	17	12
BOTANY,	44	18
ARTISTIC ANATOMY,	—	10
CLASSICS AND ANCIENT HISTORY—		
Greek,	3	2
Junior Latin,	—	2
Senior Latin,	3	3
Literature and History,	14	7
LOGIC,	—	5
ENGLISH LANGUAGE AND LITERATURE AND MODERN HISTORY—		
English Composition and Rhetoric,	17	12
English Literature,	8	3
Modern History,	26	16
FRENCH—		
Junior,	6	6
Senior,	3	5
GERMAN,	9	9

In the Department of Mathematics and Natural Philosophy, Professor Steggall reports as follows :—

"The past session has been marked by two very satisfactory events. In the first place the Mechanical Laboratory in the Technical Institute has been opened, and the students in my department have derived great advantage thereby: the additional space was much needed, and the propriety of the development of our laboratory work on the mechanical side of natural philosophy seems proved by the great interest taken by my students in this special branch of work. The practical examination in natural philosophy for the degree of B.Sc. at St Andrews largely consists of mechanics, and this gives us additional reason for appreciating this extension. The new lecture room has also proved of the greatest service.

"The second point to be noted is that the three students who have obtained the B.Sc. degree of St Andrews took subjects from this department.

"With regard to our general work it is still matter of regret that the standard of our mathematical students, who commonly profess on entering the College some considerable previous knowledge, is so low: but on the other hand it is encouraging to be able to report that during the past session some of our old students have taken up two new subjects somewhat in advance of those of former years: these are the mathematical theory of electricity, and magnetism and spherical trigonometry. Good work has been done in each of these.

"The Laboratory is very full: there are twenty-five students this year of whom several are in their second year. This is a small advance since last session, and the work is, I think, of distinctly better character, ten first-class certificates having been gained. Next session I hope to carry

out a course of practical work dealing specially with fluid motion, and having reference to the resistance of fluids to the motion of bodies through them under various circumstances: it is supposed that this work will be of use to those engaged in the shipbuilding trade.

"After five years' loyal service my friend Mr Capstick left us for Cambridge. He was succeeded by Mr John M'Cowan, whose attainments as a mathematical physicist have been of great value to my department.

"It is not often that abstract science receives encouragement here. It is therefore very pleasant to be able to report that Mr J. Martin White has presented to my department a set of models of geometrical solids."

In the Chemical Department, Professor Frankland reports:—

"In entering upon my duties at the beginning of the second term of the present session, I made it my chief endeavour to carry on the various Classes commenced by my predecessor in such a manner as to cause Students the least inconvenience by the change. I have, therefore, reserved such modifications in the course of Chemical Study as I contemplate making for the coming session.

"On the completion of the fittings in the new Dyeing and Bleaching Department, I inaugurated the practical teaching in the Dyehouse with an Evening Class, which was attended by 7 Students, whilst some of the Day Students in the Chemical Laboratory have also been engaged on experimental dyeing during the session.

"In carrying on this work in the Dyeing Department, I have been much assisted by generous contributions of materials by various firms in the neighbourhood, to whom my thanks are due.

"During the session a number of the students in the Chemical Department have presented themselves for the degree examinations of the University of St Andrews, and in all cases they have been successful.

"The congestion of students in the Chemical Laboratory has been very great, and the present accommodation is quite insufficient for the numbers. In addition to the 34 benches in the Laboratory itself, there have been some 56 boxes used for the storage of students' apparatus, whilst other students have been obliged to do their work in any available part of the building. It is almost unnecessary to point out that the occupation of the same bench and the use of the same set of reagents by different students, which the 'box system' entails, not only interferes with the comfort and convenience of the individual student, but is also very prejudicial to the efficiency of his work.

"The following is a list of the original papers which have been published in connection with my Department during the present session:—

1. "On the influence of Carbonic Anhydride and other Gases on the Development of Micro-Organisms." (Proceedings Royal Society, London.)
2. "The action of Water on Lead." (Journal of the Society of Chemical Industry.)
3. "Further experiments on the action of Water on Lead." (Journ. Soc. Chem. Industry.) In conjunction with W. Frew.
4. "Studies on some new and typical Micro-Organisms from Water and Soil." (Zeitschrift Hygiene.) In conjunction with Mrs Frankland.

In the Engineering Department, Professor Ewing reports:—

"The most noteworthy event of the year has been the

transfer of the Department to new quarters and the opening of the Engineering Laboratory. Thanks to the union of forces between the College and the Technical Institute, the Laboratory, which is now open to the use of our students of Engineering, will stand comparison in point of accommodation and equipment with any institution of the kind. The testing machine, a large part of the cost of which was generously subscribed by members of local engineering firms, was installed, along with most of the other tools and appliances, early in the session, and has been much used by both day and evening students. The machine was specially arranged by its maker (Mr Wicksteed, of Messrs Buckton & Co., Leeds) to meet the requirements of our work, and is giving the greatest satisfaction. In convenience and completeness I have not seen its equal. The steam engine, which was also specially planned with a view to educational and experimental use, was recently erected by the makers (Messrs Gourlay Brothers & Co.), who have interpreted their contract in a most liberal manner; and the trials which have already been made show that the Laboratory possesses in the engine an excellent example of the best constructive work. Its design reflects very great credit on Mr Reid, who gave up his summer vacation to the self-imposed task of preparing the drawings.

"We have still too much reason to regret the small attendance on day classes in the Engineering Department. The evening lecture class was well attended, and the new Laboratory attracted a good number of appreciative workers. Two or three day students of the Laboratory took part in work involving original research: in particular, Messrs D. Low and W. Frew gave me much useful help in an electrical investigation on "Time Lag in the Magnetisation of Iron," the results of which have been communicated to the Royal Society. The following are papers, more or less

recently published, describing experiments in which students of the Laboratory have taken part :—

"On the Magnetisation of Iron in Strong Fields" (in conjunction with W. Low). Proc. Roy. Soc., vol. xlii., 1887, p. 200. Supplemented by a paper with the same title in the Report of the British Association, 1887, p. 586.

"On the Magnetisation of Hadfield's Manganese Steel in Strong Fields" (in conjunction with W. Low). Rep. Brit. Assoc., 1887, p. 587.

"On the Influence of a Plane of Tranverse Section on the Magnetic Permeability of an Iron Bar" (in conjunction with W. Low). Report Brit. Assoc., 1887, p. 609. Printed *in extenso*, with additions in the Philosophical Magazine for September 1888, p. 274.

"On the Magnetic Qualities of Nickel" (in conjunction with G. C. Cowan). Philosophical Transactions of the Royal Society vol. clxxix., 1888, p. 325.

Do. Supplementary Paper. Phil. Trans. Roy. Soc., vol. clxxix., 1888, p. 333.

"Seismometric Measurements of the Vibration of the New Tay Bridge during the passing of Railway Trains." Proceedings, Royal Society, 1888, vol. xliv., p. 394.

"On the Magnetisation of Iron and other Magnetic Metals in very Strong Fields" (in conjunction with W. Low). Philosophical Transactions of the Royal Society, vol. clxxx., 1889, p. 221.

In the Department of Biology, Professor D'Arcy W. Thompson reports :—

"During the first term of the past session we entered upon our new Laboratory. We have therein all the space we need for practical classes and for our private work, and have already forgotten the great difficulties under which we worked before.

"Six months ago we took another step forward by starting, with ex-Provost Ballingall's help, a journal of our Laboratory work. This enterprise has given us abundant work, and has gained for us much encouragement and co-

operation elsewhere than in Dundee. We have published five papers, viz. :—

1. Mary L. Walker—*On the Form of the Quadrate Bone of Birds.* 18 pp., 100 Figures.
2. H. Lebouqq, Professeur à l'Université de Gand. *Recherches sur la Morphologie de la Carpe chez les Pinnipèdes.* 8 pp., 1 Plate.
3. Mary L. Walker—*On the Larynx and Hyoid of Monotremata.* 6 pp., 1 Plate.
4. D'Arcy W. Thompson—*On the Auditory Labyrinth of Orthagoriscus Mola.* 4 pp., 4 Woodcuts.
5. H. St. John Brooks, M.D.—*On the Morphology of the Extensor Muscles in Menobranchus, Hatteria, and Ornithorhynchus.* 19 pp., 3 Plates.

But we are still unable to publish a number of other papers which are complete in our hands, and which we are reluctant to disperse elsewhere after once starting our own publication.

"Mr John Robertson and Mr James Cunningham, jun., joined me in acquiring for the College a large series of Blaschka's glass models of invertebrate animals; and Mr J. G. Orchar helped me to furnish our rooms with a great number of portraits of naturalists.

We have received valuable specimens from the Museums of Bergen and Copenhagen, from the Royal College of Surgeons of England, from the Zoological Society, and also from Captain Adams, Captain Guy, Captain Milne, Messrs Bell of Belmont, R. N. Kerr, John Nelson, Duncan (Montrose), and other local friends. The collection of local fishes has been extended, and the type collection of insects improved. But on the whole the Museum has made little progress this year, and we have lived from hand to mouth even as regards the ordinary material for Students' work. We have distributed specimens to a great many museums and investigators

abroad, among others to Professors Cossar Ewart (Edinburgh), Giard (Paris), Leboucq (Ghent), Lütken (Copenhagen), W. K. Parker (London), Latzel (Vienna), Drs St John Brooks (Dublin), Alex. Bruce (Edinburgh), Grieg (Bergen). Donations of books and pamphlets have been, as in former years, too numerous to mention here. The Biological Section of the Naturalists' Society has held many successful meetings in the Laboratory.

"The Day Classes have fully maintained their numbers. The Evening Class in Physiology, smaller than last year's in point of numbers, has been in other respects the best evening class I have yet had."

In regard to Botany, Professor Geddes reports as follows:—

"In addition to the regular course of fifty lectures, supplemented by six excursions, the old Biological Laboratory was employed as a Laboratory of Vegetable Physiology, and a course of twenty demonstrations, fully illustrated by experiments, was given by Mr Cosmo Burton, B.Sc., during the afternoons of the first half of the term. During the five remaining weeks, microscopic, or occasionally tutorial or garden demonstrations, took the place of these. There were also three preparatory examinations.

"A class of Practical Botany, of which only the merest beginning was possible last year, was organised with very satisfactory results, being regularly attended by 16 out of the 17 students attending the lectures. In this department I have to acknowledge the constant and valuable assistance of Miss Etta Johnston and Mr A. J. Herbertson. While fully recognising the kindness of Professor D'Arcy Thompson, who, not without personal inconvenience, gave up to us the use of his Junior Laboratory, I must, however, report that fully satisfactory practical work cannot be

carried on in temporary accommodation fitted up for other special purposes.

"The superintendence of the improvements of the College Grounds, and of the continued preparations for the Botanic Garden—alike due to the liberality of Mr J. Martin White—has occupied all my available time throughout the term. In October I hope to continue this, as also to proceed with the planting of a large part of the permanent collection of herbaceous plants. Even in its present merely rudimentary state, the Garden has been of real use in teaching, while from next summer onwards, should a reasonable amount of skilled gardeners' assistance be available, it will be no less serviceable to the beginner than are more important gardens, its very smallness and simplicity being in this respect an advantage.

"The Evening course of Ten Lectures, with Microscopic or Physiological Demonstrations, was entitled 'Garden Botany,' and was attended by 16 students, chiefly gardeners. I also conducted a class of "Botany for Teachers" on Saturday forenoons, the lectures being followed by two hours' practical work or experimental demonstration. This was attended by 22 Students, nearly all teachers, and whose interest in the subject was especially gratifying. Both of these beginnings indicate possibilities of technical education which I trust we may be able to develop in future years.

"The collection of bottled specimens presented last year by the representatives of the late Professor Dickson was brought over without damage from Edinburgh at the beginning of the session, and has been of useful service as the nucleus of a Class Museum. A number of duplicates from the economic collections have also been presented by the Directors of the Royal Gardens, Kew, and a small collection of teaching models has been purchased. I have

also to acknowledge liberal donations of living plants to the Botanic Garden from Mr A. Hutton, Dundee, as also from Mr Storrie, Mr Eddie, and others. I have received from Mr C. Jenner, of Easter Duddingston, 90 copies of Howie's 'Moss Flora of Fife and Kinross,' richly and serviceably bound and interleaved for the use of collectors, with instructions to present to persons interested in the study of mosses (whether Students of the College or otherwise), and I have gratifying evidence that this valuable gift is already beginning to produce the desired effect in stimulating the study of the group. Mr Jenner is also preparing a typical collection of mosses for the Herbarium of the College."

In the Anatomy Department, Dr Paterson reports:—

"The progress made during the past year has been satisfactory, notwithstanding the fact that at the beginning of the Session no preparation had been made for the conduct of Anatomical work. Temporary accommodation has been provided in the shape of a small but well-lighted Dissecting Room, a Private Laboratory, a Lecture Room, Bone Room, and Preparation Room; the various classes have received recognition for graduation in Medicine from the University of Edinburgh; and the number of students enrolled, as well as the quality of the work done, has been highly encouraging. During the Easter vacation a number of Students of the Edinburgh University residing in the neighbourhood made use of the great facilities which the College possesses for undertaking Anatomical work. An excellent class was formed. In this way we may hope to increase our numbers in future years still more. In vacations and during the summer, no doubt many Senior Students would avail themselves of the Anatomical and Surgical Classes, especially if, at the same time, they could procure Practical Physiology and Practical Pathology. For this reason, among others,

there is a crying need for a Chair of Physiology, the possesion of which would put us in a position to complete our medical faculty.

"In addition to the ordinary Day Classes, a popular course of evening lectures on Artistic Anatomy was given during the latter half of the Winter Session. This was well attended, and at the Terminal Examination the papers given in were of an exceptionally high order. It is intended to repeat this course next winter.

"The sum of £50 subscribed some time ago by the medical men of Dundee has been partly expended in suitable instruments, apparatus, &c., for the prosecution of Pathological work; these have already been utilised by gentlemen in the neighbourhood. The Department now possesses the nucleus of a Medical Museum and Library; a number of anatomical specimens and models for teaching purposes have been bought, and we are greatly indebted to the Medical Practitioners of Dundee and others for the series of specimens (normal and pathological) which have been presented to the Department. There is a great need, however, for more specimens and more funds to enable these to be properly taken care of, and to provide for a Medical Library in the College. Already the want of books has been sorely felt, and it is hoped that before long provision will be made for both a Library and Museum. The funds at the disposal of the Department are totally inadequate for these ends, and little advance can be made towards forming a collection of books or specimens which will serve as a means of education for Medical Students either in Anatomy or Pathology until a definite sum is allotted for the purpose."

In my own Department, the fact that we are still almost entirely without University recognition continues to tell

against any striking progress. The numbers have, however, kept up to the level of last session, and the standard of work, especially in the more advanced classes, has been fairly satisfactory. I was extremely fortunate in my selection of Mr Elliot as Assistant Lecturer: he has conducted the Junior Classes with painstaking care, and has at the same time shown great ability in his lectures on Logic, which have been much appreciated. The Classical programme may now be considered fairly complete, and the Logic Courses ought to prove attractive, not only to the general student, but also to such as may still have some part of their Preliminary Examination to face before entering on the curriculum of medical study. I should like to see more advantage taken of the offer of special classes for Teachers, and also a larger attendance at the Literature and History Courses, which are addressed to the general public, as well as to the Classical Student. The subjects next session will be Greek Literature and Roman History.

In the English Department, Professor Gilray reports as follows:—

"Excellent work was done in all the Day Classes, and papers of a high order were given in at the various examinations. The English Composition Class was much larger than usual; and the students made solid progress during the Session, and five of them gained honour certificates. In the Class for the London B.A. Examination (Honours English) the students worked with the utmost enthusiasm; and they have now at their command all the materials for making themselves thorough English scholars in the strict scientific sense. In addition to studying an important period in the History of English Literature, they acquired the elements of Anglo-Saxon, and read with me the whole of 'Havelok the Dane,' and the greater part of Barbour's

'Bruce.' I confidently anticipate that these students will take their B.A. with Honours in November.

"In the work of the Evening Classes there were some very gratifying features. One lady student, Miss Syson, gave in a remarkable paper on the Constitutional History of England. I have never read a paper which showed greater grasp of the subject of examination. In the English Composition Class the work was carried on with great spirit, and six students gained honour certificates.

"The two chief defects in the work of the session were that very few students joined the English Literature Classes, and that a considerable proportion of the students did not come forward to the written examinations. I trust we shall have an improvement in both these respects next session."

Mr Durlac reports that the French and German Classes have improved in numbers, and that the work has been satisfactory, and in several instances of remarkable excellence. As will be seen elsewhere a Class will be started next session in German, especially adapted to Science Students, the chief aim of which will be to enable Students to read German scientific works in the original.

The Universities Bill has now been read a second time in the House of Commons, and if it should become law this session we may confidently expect that before long the work of the College will be conducted under much more advantageous conditions than at present. In view of the special reference made in the Bill to the foundation of a School of Medicine, we ought to congratulate ourselves on the progress we have been able to make in this Department since the date of my last Report. The Cox Chair of Anatomy

was filled by the appointment, in September of last year, of Professor Melville Paterson, who very speedily got his Department into full working order. Not long after the close of last session Mr Patrick Geddes, who had already been doing very successful work for the College, was formally appointed to the White Chair of Botany. The Directors of the Infirmary and of the Asylum have shown great cordiality towards the progress of the Medical School; and the interest taken in our operations by resident medical men may perhaps best be judged by the acceptance on the part of one of the most distinguished of their number—Dr MacEwan—of an invitation from the Council to conduct a practical class in Operative Surgery, designed for senior students and graduates. If we can continue to make such excellent progress, we may reasonably hope for a considerable addition to the number of our medical students.

Towards the end of last year the Council received from the Trustees of the late Dr John Boyd Baxter a sum of £12,000 as a permanent endowment for Professor D'Arcy Thompson's Chair of Biology. This foundation was indicated in my last report as our first great want, and it is gratifying to think that it should have been so opportunely provided. As it may be expected that the Royal Commissioners appointed under the Universities Bill will soon be at work in our midst, we must not be accused of pushing matters unduly if we now invite attention to the next great desideratum—a Chair of Physiology. The foundation of this Chair would fully secure the future of the Dundee Medical School. At present the College can give only a nominal second *annus medicus* of Practical Anatomy and Hospital work, and without Physiology the theoretical part of the curriculum will remain altogether incomplete. When this blank has been supplied the super-structure of practical teaching in such subjects as Pathology, Medicine, Midwifery,

&c., will easily be reared by the active co-operation of the medical profession in Dundee.

The resignation of Dr Carnelley, on his appointment to the Chair of Chemistry in Aberdeen University, was felt to be a great blow at the time, though no one could grudge promotion to one who had done such splendid work in the service of the College. His place was very happily filled in the beginning of the year by Dr Percy F. Frankland, who has already more than justified his election.

A beginning was made at the commencement of the Summer Term in the department of Fine Art teaching by the institution of classes under the superintendence of Miss Jack, of St Andrews. These classes it is the intention of the Council to continue next Session, when their existence will be more widely known, and when the proved ability of the teacher may be expected to attract an even larger number of Students.

A very important event in the history of the past session is the opening of the Technical Institute. In developing its operations those who are entrusted with the administration of the Institute will now have the benefit of the results of the work of the District Association for the Promotion of Technical Education, in the institution of which we took a leading part.

One Armitstead Entrance Scholarship was awarded to John R. Dick, and the Smart Bursary to A. Keiller Maxwell.

The Second Year's Science Scholarship was gained by John S. Lumsden.

Certificates of Honour (awarded to Students who have gained Five First Class Certificates of Merit) have been obtained by John R. Dick, J. S. Lumsden, Alexander Meek, and Miss Jeannie Wilson.

Three students obtained the Degree of B.Sc. at St Andrews:—John Dunn and W. D. Cargill in the department of Physical and Natural Science, and W. Low in the department of Engineering.

The following passed in the First Examination for the same degree:—J. S. Lumsden (Natural History and Botany, Natural Philosophy, Chemistry, and Practical Chemistry); Alexander Meek (Mathematics, Natural History, Practical Zoology, and Botany); Duncan Sinclair (Mathematics, Natural Philosophy, and Practical Physics); David Low (Mathematics, Mechanics, Practical Physics, and Drawing); George R. Powrie (Mechanics, Practical Chemistry, Physics, and Drawing); G. G. Hepburn (Practical Physics); H. P. Holburn (Natural History and Physiology); J. Lamb (Chemistry, Practical Chemistry, Natural History, Physiology); W. G. Smith (Natural Philosophy, Practical Physics); and D. Williamson (Practical Chemistry and Practical Physics).

Mr William B. Irvine obtained the B.A. degree of London University, and Mr David Struth passed the Intermediate Examination with Honours in English.

W. PETERSON,
Principal.

June 1889.

Presentations to the Chemical and Dyeing Departments during the Session 1888-89.

Dr James W. Miller, Dundee—Specimen of Cystine.

SPECIMENS OF DYEING MATERIALS.

Messrs James Stevenson & Sons, Dundee.
Messrs J. Pullar & Sons, Perth.
Messrs John Dawson & Co., Glasgow.

To the Engineering Department during Session 1888-89.

Subscriptions towards cost of Testing Machine (in addition to those acknowledged last year):—

H. G. Gourlay, Esq., - - -	£50	0	0
Joseph Lindsay, Esq., - - -	50	0	0
James G. Orchar, Esq., - - -	50	0	0

Messrs W. & J. Don & Co., Forfar—Dynamo Electric Machine.
P. S. Brown, Esq. (Messrs Brown & Tawse)—Steel Bars for Testing.
W. Arrol, Esq.—Treatise on the Construction of the Forth Bridge.
J. Cargill, Esq., Hamburg—Treatise on the Manufacture of Jute.

THE BIOLOGICAL DEPARTMENT has received many Donations, too numerous to catalogue in detail. The Names of the principal Donors are enumerated on page 195.

The thanks of the College are also due to the following Donors to Library:—

The Most Honourable The Marquis of Bute, K.T.
The Smithsonian Institution.
The Pharmaceutical Society.
The Bureau of Education, Washington, U.S.A.
The Geological and Natural History Survey of Canada.
The Geological and Natural History Survey of Minnesota.

The Institution of Civil Engineers.
The Institution of Mechanical Engineers.
Messrs Macmillan & Co.
Messrs Rivingtons.

For copies of their Calendars, to :—

The University of London.
St Andrews University.
The University of Edinburgh.
The University of Aberdeen.
The Victoria University.
The Royal University of Ireland.
Durham University.
University College, London.
The Heriot-Watt College, Edinburgh.
The Pharmaceutical Society of Great Britain.
The Mason Science College, Birmingham.
The City and Guilds of London Institute.
The Imperial University of Tōkyō, Japan.
University College of Wales, Aberystwyth.
University College of South Wales and Monmouthshire.
University College of North Wales.
University College, Bristol.
University College, Nottingham.
Anderson's College, Glasgow.
Dalhousie College and University, Halifax, Nova Scotia
Queen's College and University, Kingston, Canada.

DAY CLASS LISTS.

MATHEMATICS AND NATURAL PHILOSOPHY.

Junior Mathematics.

1. W. Salmond (*Prize*).
2. Miss M. L. Pattullo.
3. J. Kelly.
4. A. K. Maxwell.
5. P. J. Henderson.
6. J. Y. Murray.

Intermediate Mathematics.

First Class.

1. John R. Dick (*Prize*).

Second Class.

2. J. W. Mackison.

Senior Mathematics.

1. D. Low.
2. W. M. Mackison.

Mechanics.

1. J. Kelly (*Prize*).
2. A. Croll (*Prize*).
3 and 4. J. Martin and G. Malcolm, Jun. } Equal.
5. A. K. Maxwell.
6. J. M'Ewan.

Physics.

1. J. R. Dick (*Prize*).
2. W. G. Smith.
3. J. W. Mackison.
4. J. Whimster.
5 and 6. J. B. Mason and W. Salmond } Equal.

PHYSICAL LABORATORY.

(*Day and Evening*).

First Year, First Class.

1. J. S. Lumsden (*Prize*).
2. W. G. Smith (*Prize*).
3. W. Armour.
4. D. Ferguson.
5. A. Leighton.
6. R. Loggie.

Second Class.

7. J. R. Dick.
8. A. K. Maxwell.

Second Year, First Class.

9. D. Sinclair (*Prize*).
10. D. Williamson (*Prize*).
11. D. Low.
12. J. Mudie.

CHEMISTRY.

JUNIOR CHEMISTRY.

First Class.

1. John Whimster (*Prize*).
2. Meta Peterson.
3. J. Kelly.
   Lily Walker (*Special Prize and Certificate*).

Second Class.

4. C. Kerr.
5. W. Salmond.
6. J. W. Mackison.
7. J. Scott.
8. J. Martin.

SENIOR CHEMISTRY.

First Class.

1. J. Speakman (*Prize for Organic Chemistry*).
2. J. R. Dick (*Prize for Inorganic Chemistry*).

CHEMICAL LABORATORY.

DIVISION I. (QUANTITATIVE).

First Class.

1. J. S. Lumsden (*Prize*).
2. J. Campbell.
3. T. Anderson (Foggie, J.).

Second Class.

4. G. Caird.
5. W. G. Smith.
6. Thos. Ferguson.

Division II. (Qualitative).

First Class.

1. J. Whimster (*Prize*).
2. W. Ballingall.
3. J. R. Dick and J. Martin } Equal.

Second Class.

4. R. B. Meikle.
5. J. Kelly.

Division III. (Qualitative).

First Class.

1. Charles M'Leod (*Prize*).
2. A. M'Farlane.
3. Charles Kerr.
4. Jessie Ford.
5. James Watt and Robert Locke } Equal.
6. J. Scott.

Second Class.

7. T. Ferguson.
8. John Hume.
9. Betsy Ford.
10. F. R. Bremner.
11. William B. Thomson.

Analytical Chemistry (Lectures).

First Class.

1. John Whimster (*Prize*).
2. A. B. Harris.
3. William Ballingall.

Second Class.

4. James Scott.
5. James Meikle.
6. Jessie Ford.
7. John Hume.
8. Betsy Ford.

ENGINEERING.

Junior Engineering.

First Class.

1. John R. Dick (*Prize*).
2. Wm. Salmond.
3. George Malcolm, Jun.

Second Class.

4. John Whimster.
5. A. Keiller Maxwell.
6. John Y. Murray.
7. Joseph John Birnie.
   John R. Dick (*Special Prize for Voluntary Work*).

ENGINEERING LABORATORY.

JUNIOR.

First Clas

1. Wm Salmond (*Prize*).

SENIOR.

1. David Low.

The following worked in the ENGINEERING LABORATORY during part of the Session, and are highly commended :—

Joseph John Birnie.
W. W. R. Brownlee.
John MacEwen.
George Malcolm, Jun.
James Ferrier Mitchell.
John Y. Murray.

ELECTRICAL ENGINEERING LABORATORY.

First Class.

David Low (*Prize*).
William Frew (*Prize*).

DRAWING.

JUNIOR.

First Class.

1. Wm. Salmond (*Prize*).
2. John R. Dick.
   John MacEwen (*who attended the class for two terms, also gained a First Class Certificate.*)

SENIOR.

First Class.

3. William A. Anderson.

SURVEYING.

First Class.

1. Alex. Buttar (*Prize*).
2. James Burnett.

Second Class.

3. Charles A. Fleming.
4. John Lorimer.

ZOOLOGY.

First Class.

1. D. Findlay (*Prize*).
2 and 3. J. D. R. Duncan and A. M. Rodger } Equal.
4. D. Robb.
5. J. Braik Mason.

Second Class.

6. J. Scott.

The following Students, absent from one Examination, are entitled to First Class Certificates :—

1. Meta Peterson.
2. Margaret S. Whytock.

Summer Course.

3. John Hume (*Prize*).
4. P. Rattray.

BOTANY.

1. W. G. Smith (*Second Year, Prize*).
2. T. R. Marr (*Prize*).
3. D. Findlay and D. Robb } Equal.
4. P. Rattray, James Scott and Betsy Ford } Equal.

Saturday Class.

Essay Prize.

1. Miss Miller (*not for competition*).
2. Miss M. M. Young (*Prize*).
3. Miss Jane Smith (*Proxime Accessit*).

Commended (in Alphabetical Order).

1. Miss Llewellyn.
2. Miss N. Maxwell.
3. Miss M. Mitchell.
4. *No Name.*
5. Miss Smith.
6. Miss A. Sutherland.
7. Miss A. Young.

ANATOMY.

Descriptive Anatomy.

First Class.

1. A. Meek (*Prize*).
2. D. Findlay.

Second Class.

3. H. G. Campbell.
4. J. D. R. Duncan.

PRACTICAL ANATOMY.

First Class.

1. J. D. R. Duncan (*Prize*).

2 and 3. H. G. Campbell and E. F. D. Walker } Equal.

CLASSICS AND ANCIENT HISTORY.

JUNIOR LATIN.

First Class.

1. Miss Evelyn I. Henderson (*Prize*).

JUNIOR GREEK.

First Class.

1. John Kelly (*Prize*).

Second Class.

2. P. J. Henderson.

SENIOR LATIN.

First Class.

1. Miss A. B. Pirie (*Prize*).
2. Miss M. L. Pattullo.
   Miss R. E. White (*Special Prize and First Class Certificate*).

SENIOR GREEK.

First Class.

1. Miss A. B. Pirie (*Prize*).
   Miss R. E. White (*Special Prize and First Class Certificate*).

Second Class.

2. William Brown.

LOGIC.

WINTER COURSE.

First Class.

1. David Pae (*Prize*).
2. J. D. R. Duncan.
3. John Hume.
4. P. J. Henderson.

SUMMER TERM.

First Class.

1. Miss Fraenkl (*Prize*).
2. Charles Kerr.

ENGLISH LANGUAGE AND LITERATURE AND MODERN HISTORY.

English Literature.

Second Class.

1. Francis J. Donald (*Prize*).

Modern History.

First Class.

1. David Pae (*Prize*).

English Composition and Rhetoric.

First Class.

1. Miss Evelyn I. Henderson (*First Prize*).
2. Miss Annie Maxwell (*Second Prize*).
3. Miss Bessie Maxwell.

Second Class.

4. William Salmond.
5. John Kelly.

History of the English Language.

First Class.

1. Miss Evelyn I. Henderson (*Prize*).

Second Class.

2. John Kelly.

Anglo-Saxon or Old English.

First Class.

1. Miss Agnes B. Pirie (*Prize*).

Class for B.A London Examination (Honours English.)

First Class.

1. Miss Agnes B. Pirie (*Prize*).

FRENCH.

First Class.

1. Miss Mary S. Whytock (*Prize*).
2. Miss Ina M. White.
3. Miss Annie Maxwell.
4. Miss Bessie Maxwell.

SATURDAY CLASSES.

Greek.

First Class.

1. Miss Maggie K. Wilson (*Prize*).
2. Miss Jeannie A. Wilson.

French.

Second Class.

1. Miss Margaret Hood.
2. Miss Alice Neish.

EVENING CLASS LISTS.

MATHEMATICS.

Junior Class.

First Class.

1. ——

Second Class.

2 and 3. {John F. M'Diarmid and John Mudie} Equal.

4. G. C. B. Anderson.

CHEMISTRY.

Organic Chemistry.

First Class.

1. W. Ames (*Prize*).

Second Class.

2. R. Davidson.
3. J. R. Wilson.
4. D. Hodge.

Practical Chemistry (Advanced).

First Class.

1 and 2. {A. Lindsay and J. R. Wilson} Equal—*Prizes.*

Second Class.

3. W. Watson.

Practical Chemistry (Elementary).

First Class.

1. ——

Second Class.

1. P. M. Shepherd.

2 and 3. {W. Lowson and J. Porter} Equal.

Analytical Chemistry.

First Class.

1. D. Williamson (*Prize*).
2. D. S. Fitchet.
3. G. Caird.
4. J. Anderson.
5. A. MacFarlane.

TEXTILE FIBRES.

First Class.

1 and 2. John S. Lumsden and Alexander Fyffe } Equal—*Prizes.*
3. — Thomson.
4. George M'Ritchie, jun.
5. A. E. Kidd.
6. A. D. Munro.
7. John Lambert.

Second Class.

8. John W. Brush.
9. T. P. Marr.

ENGINEERING.

Strength of Materials.

First Class.

1 and 2. Harry B. Gourlay and Ninian R. Jamieson } Equal—*Prizes.*
3. Alexander Murray.
4. Cumming P. Jamieson.
5. Thomas Jenkins.

Laboratory Class.

First Class.

1. Alexander Murray (*Prize*).
2 and 3. Henry Fuhr and Henry Japp } Equal.
4. Ninian R. Jamieson.
5. Cumming P. Jamieson.

DRAWING.

First Class.

1. Henry Japp (*not in competition, is Highly Commended for Advanced Work*).

Second Class.

2. William B. Bruce.
3. Alexander Murray.
4. William Henderson.

PHYSIOLOGY.

1. D. S. Fitchet (*Prize*).

ANATOMY.

Artistic Anatomy.

First Class.

1. Miss E. J. Johnston (*Prize*)
2. Wm. Low.
3. D. S. Murray.
4 and 5. Mrs Beattie Bain and W. M. Grubb } Equal.

GREEK.

First Class.

1. ———

Second Class.

1. W. R. M. Brown.
2. George Mitchell.

LATIN.

Junior Latin.

First Class.

1. W. R. M. Brown (*Prize*).

Second Class.

2. Andrew Hendry.
3. William Salmond.

Senior Latin.

First Class.

1. Annie Sutherland (*Prize*).

ENGLISH LITERATURE.

First Class.

1. Murray Feathers (*Prize*).
2. Alexander H. Buglass.

ENGLISH COMPOSITION AND RHETORIC.

First Class.

1. Alexander H. Buglass (*Special Prize, Second Year's Student*).
2. William Gordon (*Prize*).
3. Donald J. Murray.
4. John Coupar.

Second Class.

5. Miss Jeannie R. Charles.
6. Andrew Hendry.

MODERN HISTORY

First Class.

1. Miss M. F. Syson (*Prize*].

Second Class.

2. Miss Mary Mitchell.
3. C. R. B. Ritchie.

FRENCH.

Senior Class.

1. Lizzie Rollo (*Prize*).
2. Charles Smart.
3. Robert Mudie.
4. James Neish.
5. G. C. B. Anderson.

Junior Class.

1. David Low.
2. John F. Stewart.
3. Thomas T. Young.

GERMAN.

1. James Kidd (*Prize*).
2. H. C. Bett.
3. Miss E. P. Marshall.

BOTANY.

1. A. Croll (*Prize*).
2. W. Mair.

UNIVERSITY OF LONDON EXAMINATIONS

OUTLINE OF THE REGULATIONS FOR DEGREES IN ARTS AND SCIENCE

(For fuller details consult the London University Calendar.*)

The Examinations are held in the University of London, but the Matriculation Examination of the University will also be held in Edinburgh (in June) and Glasgow (in January) alternately. These Examinations will be carried on simultaneously with the Examinations in London, the several papers and regulations being precisely the same. Candidates who prefer to sit at the Examinations in Edinburgh or Glasgow should notify their intention to the Registrar of the University of London. In addition to the ordinary University fees, such Candidates are required to pay to the Local Authorities a further fee (generally £2) towards the expenses attending the Provincial Examinations.

Other Examinations may be held in Scotland, whenever the number of Candidates intending to offer themselves thereat may be large enough to justify any Local Authority to institute a Provincial Centre.

Candidates failing to pass any Examination repeat the payment of the provincial fee on again coming up.

NOTE.—Every Candidate who fails to pass any Examination at his first entry thereto will be required to pay to the University an additional fee, equal to half the original fee, for every subsequent entry to the same Examination.

MATRICULATION

[N.B.—Candidates for any degree granted by the University are required to have passed the Matriculation Examination. The Matriculation Examination is accepted (1) by the Council of Military Education in lieu of the Entrance Examination otherwise imposed on Candidates for admission to the Royal Military College,

* To be obtained through any bookseller, price 4s, or on loan from College Library.

Sandhurst, except in Geometrical Drawing; (2) by the College of Surgeons in lieu of the Preliminary Examination otherwise imposed on Candidates for its Fellowship; and (3) by the Incorporated Law Society in lieu of their Preliminary Examinations. It is also among those Examinations of which some one must be passed (1) by every medical student on commencing his professional studies; and (2) by every person entering upon Articles of Clerkship to an Attorney, any such person matriculating in the First Division being entitled to exemption from one year's service.]

There are two Examinations for Matriculation in each year, one commencing on the second Monday in January, and the other on the third Monday in June. No Candidate is admitted to the Examination unless he has, not less than five weeks before the commencement of the Examination, applied to the Registrar for a form of entry, and returned it not less than four weeks before the commencement of the Examination, accompanied by a certificate showing that he has completed his sixteenth year, and by his fee for the Examination. A certified copy from the Baptismal Register, or a certificate from the Registrar-General in London, or from the Superintendent Registrar of the district, will be required in every case in which it can possibly be procured. In other cases the best evidence procurable is admitted.

SUBJECTS FOR EXAMINATION

1. Latin.—The Subjects for 1890 are—For January: *Ovid Metamorphoses*, Book I. (except 221—265, 303—317); and *Tristia*, Book III.—For June: *Cicero*, de amicitia; pro Balbo.

The paper in Latin will contain passages to be translated into English, with questions arising out of the book or books selected. Short and easy passages will also be set for translation from other books not so selected. A separate paper will be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

2. Any one of the following languages—Greek, French, German, Sanskrit, or Arabic.

N.B.—Candidates who desire to be examined in either Sanskrit or Arabic must give at least two calendar months' notice to the Registrar.

The Greek subjects for 1890 are—For January: *Euripides* Hecuba.—For June: *Xenophon*, Hellenics, Book II.

The paper in Greek will contain passages to be translated into English, with questions arising out of the book selected, and with general questions in Grammar on which special stress will be laid. Short and easy passages will also be set for translation from other books not so selected.

In French, passages will be given for translation into English, and questions set in Grammar limited to the Accidence.

The paper in German will contain passages for translation into English, and questions in Grammar limited to the Accidence.

N.B.—No credit will be given for more than one of these languages.

3. English Language, English History, and Modern Geography.
General History and Grammatical Structure of the Language.
History of England to the end of the seventeenth century, with the Geography relating thereto.
Special stress is laid on correct spelling and grammar.

4. Mathematics.—Arithmetic; Algebra, including Arithmetical and Geometrical Progressions and Easy Quadratic Equations; Geometry. The subjects of the first four books of Euclid.

5. Mechanics.—Velocity, Acceleration, Mass, Work. Composition of Forces, Moments, Centre of Mass; Fluid Pressure, and its simpler laws; Specific Gravity; Pressure of Gases and laws thereof.

6. Experimental Science.—One of the three following subjects, at the option of the candidate:—

(*a.*) Chemistry.—Non-Metallic Elements and their chief combinations; Laws of combination by weight and volume; General nature of Acids, Bases, and Salts; Symbols and Nomenclature; the Atmosphere; Combustion.

(*b.*) Heat and Light; for details see London Calendar.

(*c.*) Magnetism and Electricity; for details see London Calendar.

At two o'clock on Wednesday afternoon, in the fifth week after the Examination, the Examiners will publish a list of the candidates who have passed, arranged in three divisions: in the Honours Division in order of proficiency; in the First and Second Divisions in alphabetical order. A pass certificate, signed by the Registrar, will be delivered to each candidate who shall apply for it. If in the opinion of the Examiners any candidates in the Honours Division of not more than twenty years of age shall possess sufficient merit, the first among such candidates will receive an Exhibition of Thirty Pounds per annum for the next two years; the second among such candidates will receive an Exhibition of Twenty Pounds per annum for the next two years; and the third will receive an Exhibition of Fifteen Pounds per annnm for the next two years; such exhibitions to be paid in quarterly instalments, provided that on receiving each instalment the Exhibitioner shall declare his intention of presenting himself either at the two examinations for B.A., or at the two examinations for B.Sc., or at the first LL.B. examination, or at the Preliminary Scientific and first M.B. examinations, within three academical years from the time of his passing the Matriculation examination. Under the same circumstances the fourth among such candidates will receive a Prize to the value of Ten Pounds in books, philosophical instruments, or money; and the fifth and sixth will each receive a Prize to the value of Five Pounds in books, philosophical instruments, or money.

Any candidate who may obtain a place in the Honours Division at the Matriculation examination in January will be admissible to

the First B.A. or to the First B.Sc. examination in the following July, but such candidate will not be admissible to the second B.A. or to the second B.Sc. examination in the ensuing year, unless he shall have attained the age of eighteen years.

BACHELOR OF ARTS

Candidates are required to have passed the Matriculation examination and to pass two subsequent examinations. Nevertheless, Bachelors of Science of the University will be admitted to the degree of Bachelor of Arts after passing at the two B.A. examinations in the subjects in which they have not previously been examined. Bachelors of Arts who enter upon Articles of Clerkship to a solicitor after graduation are admissible as solicitors after three (instead of five) years' service.

INTERMEDIATE EXAMINATION IN ARTS

This Examination is held once a year, commencing on the third Monday in July. No candidate is admitted within one year of the time of his passing Matriculation, except such as have obtained Honours in the preceding January Matriculation examination. The application for forms of entry, and the certificate of good conduct, and the fee, must be sent to the Registrar as in the case of Matriculation. Fee £5.

Candidates will be examined for a Pass or for Honours in each of the subjects given below. Every candidate on sending in his name must state whether he intends competing for Honours in any subject or subjects, and if so, which.

A candidate who enters for but fails to obtain Honours in any subject, may be recommended by the Examiners for a pass in that subject, if of sufficient merit.

SUBJECTS FOR EXAMINATION

1. Latin and Roman History.—For 1890: *Virgil*, Georgics I. and II.; *Livy*, Book XXI.; simple passages of Latin from books not previously named to be translated into English, and of English to be translated into Latin, will also be given out. History of Rome to the death of Augustus. Questions in Geography and also in Grammar.

2. Greek.—For 1890: *Sophocles*, Antigone. Easy questions in Grammar will be set.

3. English Language, Literature, and History.—The Grammatical Structure of the Language: Composition: Special Subjects in 1890—History of England from 1660-1714. History of English Literature during the same period. *Milton:* Paradise Lost. *Chaucer:* Prologue, Knight's Tale, Second Nun's Tale. *Dryden:* Essays on Dramatic Poesy. *Addison:* Essays on Milton in the Spectator.

4. Mathematics.—Arithmetic, Algebra, Geometry, Plane and Co-ordinate, Plane Trigonometry.

5. Either French or German. Translation into and from English, with questions in Grammar.

N.B.—For the Honours subjects the London Calendar must be consulted.

The following Exhibitions are awarded in connection with the above examinations :—

In Latin,	. .	£40 per annum for two years.
In English,	. .	£30 ,, ,,
In Mathematics,	.	£40 ,, ,,
In French,	. .	£10 in books or money.
In German,	. .	£10 ,, ,,

B.A. FINAL EXAMINATION

This Examination is held once a year, commencing on the fourth Monday in October. No candidate is admitted to this examination within one year of the time of his passing the Intermediate Examination in Arts unless he have previously taken the degree of B.Sc. Candidates who have been admitted to the Intermediate Examination in Arts within six months after passing the Matriculation Examination must have completed their eighteenth year. The application for forms of entry and the certificate of good conduct and the fee are to be sent up as in the case of Matriculation. Fee £5.

Candidates shall be examined in the following Branches of Knowledge; Branches I., II., and III. being compulsory, but an option being allowed between Branch IV. and Branch V. :—

I. Latin, with Roman History (Two Papers).
II. Greek, with Grecian History (Two Papers).
III. *One* of the following Languages :—English, French, German, Italian, Arabic, Sanscrit. (Two Papers in each.)
IV. Either *Pure* Mathematics, or *Mixed* Mathematics. (Two Papers in each.)
V. Mental and Moral Science (Two Papers).

Various Scholarships and Prizes are offered for competition in this examination.

MASTER OF ARTS

Examinations held yearly, commencing on the first Monday in June. Candidates to be not less than twenty years of age, and B.A. of at least one year's standing in the University. The application for forms of entry and the certificate with the fee to be sent up, as in the case of Matriculation before, the Examination. Fee £10.

No Candidate will be approved by the Examiners unless he show a competent knowledge in one of the following branches of knowledge:—

I. Classics.
II. Mathematics and Natural Philosophy.
III. Mental and Moral Science, Political Philosophy, History of Philosophy, Political Economy.
IV. Any two of the following :—
(1) English, including Anglo-Saxon; (2) French; (3) German; (4) Italian; (5) Hebrew; (6) Sanskrit; (7) Arabic.

DOCTOR OF LITERATURE

Candidates are required to have passed the M.A. Examination in Branch I., and also in either Branch III. or Branch IV.

Examinations held once a year, commencing on the first Tuesday in December. *Candidates must give notice of their intention to compete*

on or before the 1st of October. They are required to have passed the M.A. Examination at least one year previously. Fee £10, to be paid on or before the 1st of October.

Candidates are required to transmit, not later than October 1st, an original Printed Essay or Thesis upon some special subject within the purview of Branch I., or III., or IV., of the M.A. Examination. (For further particulars see Calendar.)

BACHELOR OF SCIENCE

Candidates are required to have passed the Matriculation Examination, and to pass two subsequent examinations.*

Intermediate Examintion in Science, held annually, commencing on the Third Monday in July. No candidate (except those who have obtained Honours at the preceding January Matriculation) is admitted to this examination within one academical year of his Matriculation. Certificates, &c., to be sent to the Registrar as in the case of Matriculation (see page 219). Fee £5.

SUBJECTS FOR EXAMINATION

For a Pass *or* for Honours in :—

1. Mathematics.
2. Experimental Physics.
3. Inorganic Chemistry.

And for a Pass only in :—

4. General Biology.

Candidates may also be examined for Honours in Botany and Zoology.

N.B.—The written examination will be followed by a *practical examination* in Chemistry and Biology.

B.Sc. Examination, held once a year, commencing on the third Monday in October, and extending over three weeks. Candidates are required to have passed the Intermediate Examination in Science at least one year previously; and those who have been admitted to the Intermediate Examination in Science within six months after passing the Matriculation Examination must have completed their eighteenth year. Certificates, &c., to be sent up as in the case of Matriculation (see page 219). Fee £5.

Candidates will be required to show a competent knowledge of *any three* which they may select out of the nine following subjects :—

1. Pure Mathematics.
2. Mixed Mathematics.
3. Experimental Physics.
4. Chemistry (Theoretical and Practical).
5. Botany (Theoretical and Practical).
6. Zoology (Theoretical and Practical).
7. Animal Physiology (Theoretical and Practical).
8. Physical Geography and Geology (Theoretical and Practical).
9. Mental and Moral Science.

* Bachelors of Arts of the University who are candidates for the degree of B.Sc. will be exempted from examination in Mathematics at the Intermediate Examination in Science, and from payment of the Fee of Five Pounds at the B.Sc. Examination.

The names of the candidates who have passed the Intermediate Examination in Science and the B.Sc. Examination, and the Prel. M.B. Examination (see below), are published on the Saturday in the week following the last week of each examination, arranged in two divisions, each in alphabetical order.

Examinations for Honours are held after both the Intermediate and B.Sc. Examinations and after the Prel. M.B. Examination, and various Scholarships and Exhibitions are offered for competition.

DOCTOR OF SCIENCE

Examinations held annually, within the first twenty-one days of June. Candidates must be B.Sc. of two years standing.

Candidates must obtain a form of entry from the Registrar, and return it, with their fee of £10, to the Registrar of the University on or before the 1st of February.

DEGREES IN MEDICINE

Preliminary Scientific (M.B.) Examination

Examination held twice annually—once for a Pass and Honours, commencing on the second Monday in July; and once for Pass Candidates only, commencing the third Monday in January.

Candidates are required to have passed the Matriculation Examination or taken a degree in Arts as mentioned above. The same notice must be sent to the Registrar as in the case of Matriculation (page 219). Fee £5.

Candidates for the degree of M.B. are required by the Senate to have passed the Preliminary Scientific Examination before commencing their medical studies, and are recommended to devote a preliminary year to preparation for it.

SUBJECTS FOR EXAMINATION

[Candidates who pass in all the subjects of the examination and also *at the same time* in the Mathematics of the Intermediate Examination in Science are considered as having passed both the Prel. Sc. and the Intermediate Examination in Science, and those who pass in all the subjects of the Prel. Sc. (M.B.) Examination, and have *previously* passed the Intermediate Examination in Arts, are admissible to the B.Sc. Examination.]

1. Inorganic Chemistry by *viva voce* and experiment as well as by printed papers. [Qualitative Analysis of the more commonly occurring Bases and Inorganic Acids in solutions, containing one of each.]
2. Experimental Physics.
3. General Biology.

Candidates will be allowed, upon giving due notice, either to take all the three subjects at the same examination, or at two separate examinations.

ST ANDREWS UNIVERSITY.

REGULATIONS FOR GRADUATION IN SCIENCE.

[*All communications regarding Examinations and Degrees in Science are to be made to the Convener of the Committee on Science Degrees. All fees are to be paid to the Secretary of the University.*]

Two degrees in Science are conferred by the University of St Andrews,—namely, Bachelor of Science (B.Sc.) and Doctor of Science (D.Sc.).

QUALIFICATIONS REQUIRED IN CANDIDATES FOR SCIENCE DEGREES.

I. Candidates for these degrees must, unless exempted, pass a preliminary examination in English, Latin, Arithmetic, the Elements of Mathematics, the Elements of Mechanics, and at least two of the following subjects: Greek, French, German, Higher Mathematics, Experimental Physics, Logic, Moral Philosophy, Physiology, Chemistry, Natural History, Botany.

SUBJECTS OF PRELIMINARY EXAMINATION.

A.—Compulsory subjects.

ENGLISH.—(1.) Writing a passage of English from dictation; (2.) English Composition, with the correction of sentences of bad English; (3.) Questions in English Grammar, with analysis of sentences, and the derivation and definition of some common English Words; (4.) Questions in Geography and History, especially in the History of the British Islands, and of English Literature.

LATIN.—Virgil's Æneid, Book II.; Horace, Odes, Book II.; grammatical questions; an easy passage of Latin for *ad aperturam* translation into English, and of English for translation into Latin.

ARITHMETIC.—The common rules, including Vulgar and Decimal Fractions.

ELEMENTS OF MATHEMATICS.—Geometry—Euclid, Books I., II., and III., or their equivalent—Algebra, as far as Simple Equations inclusive.

MECHANICS.—Blaikie's Elements of Dynamics.

B.—Optional subjects, of which at least two must be selected.

GREEK.—Xenophon's Anabasis, Book IV., amd a simple unseen Greek passage for translation into English; also the translation of an English passage into Greek.

FRENCH.—Voltaire's life of Charles XII., with easy passage for translation into French, and grammatical and historical questions.

GERMAN.—Schiller's Wilhelm Tell, with grammatical questions, and short passage in English for translation into German.

HIGHER MATHEMATICS.—Geometry—Euclid, Books I.-IV. and VI. —Algebra, to Quadratic Equations, and Elementary Trigonometry to Solution of Triangles.

EXPERIMENTAL PHYSICS.—Balfour Stewart's Lessons in Elementary Physics.

MORAL PHILOSOPHY.—Sidgwick's History of Ethics, *or* Herbert Spencer's Data of Ethics.

LOGIC.—Jevons's Elementary Lessons in Logic.

PHYSIOLOGY.—Kirke's Handbook of Physiology (latest ed.); or Dalton's Text-book of Human Physiology; *or* the same by Landois and Stirling.

CHEMISTRY.—Ira Remsen's Elements of Chemistry.

NATURAL HISTORY.—Nicholson's Outlines of Zoology.

BOTANY.—Henfrey's Elementary Botany.

No Candidate will be admitted to the Science Examinations till he has passed the Preliminary Examination.

Exemptions from the Preliminary Examination are—

(*a.*) Bachelors or Masters of Arts by examination in any British or recognised Indian or Colonial University.

(*b.*) Doctors or Bachelors of Medicine or Surgery by examination in any British or recognised Indian or Colonial University.

(*c.*) Holders of two departmental certificates in the Faculty of Arts in any Scottish University.

(*d.*) Matriculated Students of the University of London.

(*e.*) Students who have passed the Preliminary Medical Examination in any Scottish University are exempted from examination as regards the subjects that are identical in the Preliminary Medical Examination and in the Preliminary Examination for Science Degrees.

(*f.*) Holders of the Senior Certificate of the Local Examination of any Scottish University are exempted as regards the subjects in which they have passed in the Local Examination.

(*g.*) Students of St Andrews who have passed the examination for the three years' course for the Degree of M.A. are exempted as regards the subjects included in that examination.

(*h.*) Holders of First-Class Certificates from Normal Training Colleges.

II. Candidates for these Degrees, on giving in their names for any Science Examination, must produce evidence of attendance on qualifying[1] Science classes, embracing all the subjects in which they are to be examined.

(1) For explanation of the term "qualifying" see Rule IV.

III. The attendance on these classes must extend over at least three academic years, one of which must be spent at the University of St Andrews, and the other two at Universities or Institutions recognised and approved of by this University.

[This last regulation is not binding on students attending University College, Dundee, provided that such students, having matriculated each year at the University of St Andrews, spend three academic years in attendance on qualifying Science classes at University College, Dundee.]

IV. Each Academic Year must be constituted by attendance on Science classes, consisting of two or more courses, embracing, together, at least 150 lectures; and no single course will be considered as *qualifying*, unless it consist of at least 50 lectures.

In constituting an Academic Year, a course of at least 50 hours' work—spread uniformly over not less than three months—at a Practical Laboratory, in any of the subjects of examination, will be reckoned as equivalent to a course of 50 lectures: and similarly a course of at least 100 hours' work—spread uniformly over not less than five months—will be reckoned as equivalent to a course of 100 lectures.

V. Every Candidate for a Degree in Science must be matriculated at this University for the Academic Year in which he appears for examination.

DEGREE OF BACHELOR OF SCIENCE.

There are two departments for this degree—namely, that of Physical and Natural Science, and that of Engineering.

I. Department of Physical and Natural Science.

In this department there are *two* examinations, which are conducted in writing, orally, and in Practical Laboratory work.

In the first of these examinations (1st B.Sc. Examination) each Candidate will be examined in *seven* subjects, namely—

(*A.*) *Three* to be chosen from among
- Mathematics.
- Natural Philosophy.
- Chemistry.
- Natural History.
- Physiology.
- Botany.

(*B.*) And *two* from among
- Practical Physics.
- Practical Chemistry.
- Practical Zoology.
- Practical Physiology.
- Practical Botany.

[With regard to the subjects in group (*B*), it must be clearly understood that the Candidate must have been through a qualifying course of Practical Laboratory work in each of the two subjects he selects. He must also be prepared to undergo an *elementary* practical examination in each of the subjects he selects from group (*A*.)]

The candidate may appear for examination at any period of examination subsequent to attendance on the proper qualifying classes; and must take at least *two* subjects on each occasion.

N.B.—(*a*.) Graduates in Arts of the University of St Andrews are exempted from examination on the subjects in which they have passed for the Degree of Master of Arts.

(*b*.) Bachelors or Doctors of Medicine of this University who have taken honours in the Natural Sciences at their professional examinations, are exempted from examination in the subjects in which they have taken honours.

A Candidate who has passed this *first* Examination may proceed to h *second* (2d B.Sc. Examination) after an interval of six months, ρ. ovided that by that time he has completed his full course of three academic years.

For this examination the Candidate must restrict his studies to some special group of the Physical and Natural Sciences, in which he is expected to show accurate and detailed knowledge.

The Candidate will be subjected to examination in *one* of the following groups:—

A. Higher Mathematics, and Natural Philosophy.
B. Experimental Physics, and Chemistry.
C. Chemistry, and Physiology.
D. Physiology, and Zoology including Palæontology.
E. Zoology and Botany.

SUBJECTS OF FIRST B.SC. EXAMINATION.

Mathematics.

(*a*) Geometry—Euclid, Bks. I. to VI., XI., Props. 1-21; the *principal* properties of the Parabola, the Ellipse, and the Hyperbola. (*b*) Elements of Trigonometry. (*c*) Algebra up to and including Quadratic Equations, Progressions, to Exponential Theorem and Convergency, Permutations and Combinations. (*d*) Analytical Geometry up to and including the circle.—There will be two papers, one on (*a*) and (*b*), the other on (*c*) and (*d*), and candidates will require to satisfy the examiners in each of the four subjects (*a*), (*b*), (*c*), and (*d*).

Natural Philosophy.

(*a*) APPLIED MATHEMATICS—including the treatment by Elementary Geometry, Algebra, and Trigonometry of the following subjects (such as may reasonably be acquired in one or two sessions' attendance at a course of Natural Philosophy)—

Kinematics—including Velocity, Acceleration, Angular Velocity, Simple Harmonic Motion, &c., and their composition and resolution.

Abstract Dynamics—including Elementary Statics, Kinetics, Hydrostatics, and Elementary Rigid Dynamics.
Geometrical Optics.
Plane Astronomy.

(*b*) EXPERIMENTAL PHYSICS—including
Laws of Motion.
Properties of Matter.
Sound and Harmonics.
Light, with the fundamental principles of the Undulatory Theory.
Heat, with the fundamental principles of the Dynamical Theory.
Electricity—including the Experimental laws of Static and Galvanic Electricity, Induction, Magnetism, and Electro-Magnetism.

Practical Physics. — Elementary Measurements in Mechanics, Optics, and Heat.

Chemistry.

Distinguishing characteristics of chemical and physical changes; of simple and compound matter and mechanical mixture.

Laws of Chemical Combination.

The Atomic theory. Methods of determining molecular and atomic weights. Valency.

Symbolic Notation. Calculation of quantities by weight and volume. Metric system of weights and measures.

Nature of Acids, Bases, and Salts.

Electrolysis of salts.

Diffusion of Gases.

Outlines of Crystallography.

Systems of Classification of Elements.

Preparation and Properties of the non-metallic elements, of the common metals, and of their chief inorganic compounds.

Marsh Gas. Olefiant Gas. Manufacture of Coal-gas. Theory of flame.

Practical Chemistry.—Simple qualitative analysis, *or*, Simple quantitative experiments.

Natural History.

(Including Comparative Anatomy and Palæontology.)

The characters of living beings, and the distinctions between the Animal and Vegetable Kingdoms.

The general principles of Animal Morphology, Reproduction and Embryology, and Systematic Zoology or Classification.

The general structure, physiology, and development of the following groups of animals, and their distribution in time and in space :—

Protozoa.
Monera, Rhizopoda, Infusoria.

Metazoa.
Porifera, Hydromedusæ, Actinozoa.
Echinodermata, Vermes.
Crustacea, Arachnida, Myriopoda, Insecta.

Polyzoa, Tunicata, Brachiopoda, Lamellibranchiata, Gastropoda. Pteropoda, Cephalopoda.

Pisces, Amphibia, Reptilia, Aves, Mammalia.

The Candidate will be required to refer to its proper group, amongst those named above, any specimen which may be exhibited for this purpose by the Examiner.

Practical Zoology.

Candidates wishing to take this subject are referred to the Professor of Natural History, St Andrews, for information regarding the examination.

Physiology.

The Candidate must show a general knowledge of the following:—

The Chemistry and the Physical Properties of the Solids and Fluids of the Body.

The Microscopic structure of the Simple and Compound Tissues; and the use of Physiological Apparatus.

The general process of Nutrition: Foods—Mastication—Insalivation—Deglutition—Gastric Digestion—The Liver, its structure and function—The Pancreas, its structure and function—The ductless Glands, their structure and function—The intestinal Glands—Digestion in the intestine.

Absorption from the intestine—The Lacteals and lymphatic system.

The Blood: Its composition—The circulation of the Blood—How temperature is maintained.

The Lungs, and the general process of Respiration.

The Secretory and Excretory Organs; the functions performed by these.

The Nervous System: Functions of the Cerebrum—of the Cerebellum—of the Spinal Cord—Reflex actions—Sensibility and Sensation—The Special Senses.

Practical Physiology.

Candidates wishing to take this subject are referred to the Professor of Medicine, St Andrews, for information regarding the examination.

Botany.

A. *Structural Botany.*—(1) Histology: Structural elements,—their general character, chemical and anatomical. General structure of roots, stems, and leaves. (2) Organography: General character of the nutritive and reproductive organs of Thallophytes, Muscineæ, Vascular Cryptogams, and Phanerogams.

B. *Physiological Botany.*—(1) Nutrition: Absorption, Elaboration out of inorganic material, Digestion, Respiration, Movement of the Sap, Growth. (2) Reproduction: Fertilisation and Embryology in Phanerogams and Cryptogams.

C. *Systematic Botany.*—Candidates will be examined practically on any of the following natural orders:—Ranunculaceæ, Papaveraceæ, Cruciferæ, Caryophylleæ, Malvaceæ, Leguminosæ, Rosaceæ, Umbelliferæ, Compositæ, Solanaceæ, Scrophularineæ, Labiatæ, Notiaecæ, Coniferæ, Liliaceæ, Amaryllidaceæ, Orchidaceæ, Gramineæ, Filices, Musci.

Practical Botany.

Candidates wishing to take this subject are referred to the Professor of Natural History, St Andrews, for information regarding the examination.

SUBJECTS OF SECOND B.SC. EXAMINATION.

Mathematics.

The Candidate will be subjected to a general examination in Geometry, Trigonometry, Algebra, Analytical Geometry, and the elements of the Differential and Integral Calculus, and to a special examination on three or more subjects selected by the Candidate from the following list. A note of the special subjects selected must be submitted for approval, addressed to *the Professor of Mathematics, St Andrews,* six weeks previous to the examination.

List of Subjects, with Books or portions of Books recommended.—(1) *Algebra,* Todhunter, Kelland, Gross, Aldis, Hall and Knight, Smith. (2) *Plane Trigonometry,* Todhunter, Walmsley, Lock, Johnson. (3) *Spherical Trigonometry,* M'Lelland and Preston, Todhunter, Snowball. (4) *Theory of Equations,* Burnside and Panton, chaps. i.-x. and xii., or Todhunter's Theory of Equations, i.-xviii. (5) *Determinants,* Muir's Determinants, Salmon's Lessons in Higher Algebra, or Burnside and Panton's Theory of Equations. (6) *Analytical Geometry of two dimensions, including Parabola, &c., up to end of General Equation of Second Degree, with the elements of abridged notation,* as in Salmon's Conic Sections, C. Smith, Casey, or Todhunter. (7) *Analytical Geometry of three dimensions;* Salmon's Geometry of three dimensions, and C. Smith's Solid Geometry. (8) *Differential Calculus,* Todhunter, Williamson. (9) *Integral Calculus,* Todhunter or Williamson or Greenhill's Differential and Integral Calculus. (10) *Quaternions,* Kelland and Tait, chaps. i.-ix.

Candidates are recommended to consult with the Professor of Mathematics before selecting their special course of reading.

N.B.—The Candidates will be tested as much as possible for soundness of Elementary knowledge; extensive reading is of secondary importance. It is not imperative that the Candidate should read the books above mentioned; others covering much the same ground may be substituted.

Natural Philosophy.

The Candidate will be subjected to a general examination in Dynamics and Physics, and to a special examination on two or three books, such as the following, to be selected by the Candidate, and

subject to the approval of the Professor. The list to be sent to *the Professor of Natural Philosophy, St Andrews*, six weeks previous to the examination.

(1) Thomson and Tait's Elements of Natural Philosophy. (2) Tait and Steele's Dynamics of a Particle. (3) Todhunter's Statics. (4) Routh's Rigid Dynamics. (5) Newton—three sections. (6) Parkinson's Optics. (7) Lloyd's Lectures on the Undulatory Theory of Light. (8) Airy's Tract on Light. (9) Balfour Stewart on Heat. (10) Clerk-Maxwell on Heat. (11) Rayleigh on Sound. (12) Lamb's Treatise on the Motion of Fluids. (13) Minchin's Statics.

Experimental Physics.

Candidates will be required to show practical familiarity with the processes required for the determination of physical constants—viz., Acceleration of Gravity; Specific Gravities of various Substances; Velocity of Sound; Specific Heats; Co-efficients of Expansion; Mechanical Equivalent of Heat; Indices of Refraction; Lengths of Light-Waves and others; and for the verification of Physical Laws, such as Boyle's Law; Laws of Elasticity; of Electric Repulsion; of Electric Currents; of Reflection and Refraction of Light; of Radiation; and others. The examination will be conducted partly in writing and partly in laboratory manipulation. The written examination will consist of two papers, the first of a general character, and the second relating to special processes and experiments in Physics.

Chemistry.

Inorganic Chemistry treated more fully than at the First Bachelor of Science Examination. The Elements of Organic Chemistry. Methods of Analysis.

Practical Examination.—Complex qualitative analysis, and simple quantitative estimations.

Physiology.

The Candidate will be examined in the subjects of the First Bachelor of Science Examination, but in greater detail. In addition, he will be expected to show a knowledge of the processes of Reproduction and Development.

Zoology.

(Including Comparative Anatomy and Palæontology.)

The same subjects as for the First Bachelor of Science Examination, but carried out in greater detail.

Botany.

The same subjects as for the First Bachelor of Science Examination, with the addition of Fossil Botany.

II. Department of Engineering.

For the Degree of B.Sc. in the Department of Engineering, there will be two Examinations.

First Examination.

I. *Mathematics.*—(*a*) Geometry—Euclid, Bks. I. to VI., XI., Props. 1-21; the *principal* properties of the Parabola, the Ellipse, and the Hyperbola. (*b*) Elements of Trigonometry. (*c*) Algebra, up to and including Quadratic Equations, Progressions, Logarithms, Permutations and Combinations, Binomial Theorem. (*d*) Analytical Geometry, up to and including the circle.—There will be two papers, one on (*a*) and (*b*), the other on (*c*) and (*d*), and Candidates will require to satisfy the examiners in each of the four subjects (*a*), (*b*), (*c*), and (*d*).

II. *Mechanics* and *Elements of Geometrical Optics*, including Laws of Motion, Measurement and Composition of Velocity, Acceleration, Angular Velocity and Acceleration, Simple Harmonic Motion; Dynamics, including Statics and Kinetics of Solids and Elements of Hydrostatics, Measurement and Composition of Force, Momentum, &c. Distributed Forces: Moment of Inertia; Centre of Gravity; Friction; Simple Machines.

III. *Experimental Physics*, including Properties of Matter, Conservation of Energy; Elements of Heat, Light, Sound, Electricity, and Magnetism.

In these three parts of the Examination (I., II., and III.) the standard required will be that of a *good* pass in M.A. Degree Examination.

IV. *Chemistry.*—Elements of Inorganic Chemistry, with special reference to Metallurgy.

V. *Drawing.*—The Student will be required to make figured sketches from measurement of actual machines, and to prepare working drawings from the sketches.

The Student will also have to pass an Elementary Practical Examination in Chemistry (Qualitative Analysis) and in Physics (General Laboratory Practice). The conditions for exemption are the same as for the other Science Degree.

Second Examination.

The Candidate for the B.Sc. Degree in Engineering may proceed, not sooner than three years from the beginning of his course, to the *second* Examination, which will be written, oral, and practical, the subjects being—

I. *Engineering.*—The subjects in this Examination are—Strength of Materials; Theory of Structures; Theory and Construction of the Steam Engine and other Heat Engines; Mechanism and Machine Design; Hydraulics; Sanitary Engineering; Surveying, Levelling, and Setting Out.

II. *Drawing.*—The Candidate must be prepared to undergo a second examination in drawing and drawing office work—including the preparation of working and finished drawings of machines, drawings of surveys, tracings, blue-prints, &c.

III. Either *A.—Mathematics applied to Mechanics ; or*

B.—Electricity, Pure and Applied.

A. will include the application of Mathematics as far as the rudiments of the Differential and Integral Calculus to Kinematics ; Statics of Rigid Solids ; Elastic Bodies and Perfect Fluids ; Kinetics of a Particle and of Rigid Solids ; and the simplest portions of the Kinetics of Fluids.

B. will include—

ELECTRICITY.
- *α.* Electrostatics.
- *β.* Magnetism.
- *γ.* Laws of Electric Currents : Electro-magetism ; Electro-magnetic and Practical Units.

[The above subjects will be treated experimentally and mathematically, as far as the rudiments of the Differential and Integral Calculus.]

Also—

ELECTRICAL ENGINEERING.
- *δ.* Practical methods of Electrical Measurement.
- *ε.* Production of Electricity, Dynamics, Batteries, Secondary Batteries.
- *ζ.* Electric Lighting.
- *η.* Electric Transmission of Power.
- *θ.* Telegraphy.

Candidates who have passed the 1st and 2nd Bachelor of Science Examination, will be recommended to the Senatus for the Degree of Bachelor of Science, which will be conferred at the usual Graduation Ceremony.

PERIODS OF EXAMINATION AND FEES.

The Preliminary Examination for the Degree of Bachelor of Science will be held in March and October each year, simultaneously with the Preliminary Examinations in Medicine. Candidates for this examination are requested to give in their names to the Secretary of the University not later than 15th February and 15th September, at the same time stating in what subjects they wish to be examined.

The Examinations for the Degrees of Bachelor and Doctor of Science will be held in April and October of each year, at the time when the examinations for the M.A. degree are in progress. Candidates for either of these examinations must announce their names to the *Convener of the Committee on Science Degrees*, not later than the 1st March and the 1st October of each year.

They must also state—

(i) In what subjects they propose to be examined.

(ii) In what subjects they have already passed, and at what date or dates.

They must also enclose certificates of attendance on the requisite qualifying classes, as set down in Regulation II.

On or before the 1st March and the 1st October, previous to their examination, they must pay to the *Secretary of the University* the necessary fee or fees, according to the following table:—

For preliminary examination, or for registration of qualification, ...	£1 1 0
For the first Bachelor of Science Examination, . .	2 2 0
For the second Bachelor of Science Examination, .	2 2 0
For the Doctor of Science Examination, ...	5 5 0
	£10 10 0

[Candidates who have passed the first Bachelor of Science Examination, and who have taken Honours in the Department of Mathematics for the Degree of M.A., are exempted from the Second Bachelor of Science Examination on paying the fee.]

DEGREE OF DOCTOR OF SCIENCE.

Department of Natural and Physical Science.

Should the Candidate, after obtaining the Degree of Bachelor of Science, desire to proceed to the Degree of Doctor of Science, he may, after the lapse of twelve months, present himself for the Doctor of Science examination. For this examination the Candidate must profess one, and not more than one, of the subjects belonging to the group in which he proceeded to the Degree of Bachelor of Science; and he must further profess some special branch of that subject, to which he has devoted special attention, and in which he believes himself to have attained special knowledge. He must also present a thesis embodying some original researches on the subject of his intended examination, and this must be approved of by the examiners. Should the Candidate satisfy the examiners that he has obtained this thorough knowledge of his subject, he may, provided he has reached the age of twenty-one years, be recommended to the Senatus for the Degree of Doctor of Science.

Mathematics.

The Candidate will be required to show very high attainments in one of the following subjects: (1) Geometry and Trigonometry; (2) Analytical Geometry; (3) Algebra; (4) The Differential Calculus generally; (5) Special departments, such as the Calculus of Variations, the Theory of Determinants, Quaternions, &c.

Natural Philosophy.

Candidates are required to pass a *searching* examination in *one* of the following subjects or groups of subjects (in all its details), and to show more than a mere elementary knowledge of at least *two* others.

A.—Applied Mathematics.

1. *Abstract Dynamics*, including *Kinematics.*
2. *Acoustics* and *Theory of Light.*
3. *Conservation of Energy*, including the *Dynamical Theory of Heat.*

4. *Electricity*, including the mathematical theories of *Static and Voltaic Electricity*, *Induction*, *Magnetism*, and *Electro-Magnetism*.
5. *Physical Astronomy*, including the *Lunar* and Planetary Theories, the *Figure of the Earth*, *Precession*, and *Nutation*.

B.—Experimental Physics.

6. *Properties of Matter*.
7. *Sound and Light*.
8. *Heat and Energy* (generally).
9. *Electricity*, *Magnetism*, &c.

Chemistry.

The Candidate may choose either of the two undermentioned branches as *Principal Subject*, and the other as *Subsidiary Subject*. He will be expected to have a general acquaintance with the *Subsidiary Subject*, and to be so fully conversant with the *Principal Subject* as to be able to pass any examinational test that can be fairly applied.

The branches referred to are—

1. Inorganic Chemistry, including Crystallography and the Chemical Technology of Inorganic substances.
2. Organic Chemistry, including either the Chemistry of Animal and Vegetable Life, or Chemical Technology in its relations to Organic Chemistry.

Zoology, including Comparative Anatomy and Palæontology.

The same subjects as for the Bachelor of Science Examination. In addition to a competent acquaintance with the structure, development, and classification of animals, special knowledge of a group (e.g., the *Mollusca*), to be selected by the Candidate and approved by the Examiner, is required. The Candidate must submit an original thesis upon some Zoological subject selected by himself.

Physiology.

In addition to a searching examination in general Physiology, the Candidate will require to know the Comparative Physiology of the Nervous, Circulatory, and Respiratory Systems. He will be examined in Histology, Physiological Chemistry, and Physiological Physics. He will also have to present an original thesis on some subject in Physiology, to be selected by himself, and this thesis must be approved by the Examiner.

DEPARTMENT OF ENGINEERING.

The Candidate must have been a B.Sc. in Engineering, of this University, for not less than twelve months, and must be at least twenty-one years of age, and must have been engaged in actual practice for at least two years.

He must satisfy the examiners that he possesses an *intimate* knowledge of—

1°, The theory and the practice of some one branch of Civil or Mechanical Engineering, such as Bridge Construction, Water Supply, Sewerage, Railways, Shipbuilding, Steam Engine Construction, the Manufacture of Iron, Electric Lighting, or Telegraphy.

2°, Some branch of applied science directly related to Engineering, as Applied Mathematics, Geology, Technological Chemistry, one branch of Natural Philosophy, &c.

The Candidate will specify the branch under each head in which he wishes to be tested.

As regards 1°, he will be required to submit as his own work a complete set of drawings, specifications, and estimates for some prescribed piece of Civil or Mechanical Engineering work. The work prescribed will be chosen with reference to the branch of Engineering in which the Candidate has been specially engaged. One month will be allowed for the preparation of the necessary drawings, &c. These, with all the detailed calculations on which they have been based, must be sent in to the Examiners. If they are approved, the Candidate will be subjected to an examination for the purpose of verifying their authenticity, and of ascertaining the sufficiency of the Candidate's professional ability. As regards 2°, the Examiners *may* accept in lieu of an examination a Thesis embodying the results of the Candidate's independent original researches on the branch of applied science selected by him, should they consider it sufficient.

UNIVERSITY OF EDINBURGH.

GRADUATION IN SCIENCE.

Two degrees in science are conferred by the University of Edinburgh, viz. :—Bachelor of Science (B.Sc.), and Doctor of Science (D.Sc.). Both these degrees are conferred in (A) Physical and Natural Science, (B) in Engineering, and (C) in Public Health.

In departments (A) and (B) attendance on Science Classes for three academical years is required to qualify for graduation. The Dundee University College is recognised by the University of Edinburgh as an institution at which two of these three academical years may be passed.

The following is an outline of the regulations and subjects of examination in Departments (A) and (B).

DEPARTMENT (A), PHYSICAL AND NATURAL SCIENCE.

1. General Regulations.

Preliminary Examination.—Candidates for degrees in Physical and Natural Science must, *unless exempted**, pass a Preliminary Examination in English, Latin, Arithmetic, Elements of Mathematics, Elements of Mechanics, and in at least two of the following subjects :—Greek, French, German, Higher Mathematics, Natural Philosophy, Logic and Moral Philosophy. [Fee, £1 1s.]

Qualifying Attendance.—The attendance on Science Classes for the Degree of Bachelor of Science must extend over three academic years, one of which must be passed at the University of Edinburgh (see p. 49 above).

Each academic year must be constituted by attendance on Science Classes during at least two full winter courses of lectures, or one full winter course and two full summer courses. Work in a scientific laboratory over a period of not less than five months is reckoned equivalent to a full winter course of lectures, and work in a scientific laboratory over a period of three months is reckoned equivalent to a full summer course of lectures.

Classes of Chemistry, of Practical Chemistry, of Botany, and of Zoology, which are recognised for the First Professional Examination for Degrees in Medicine, are also recognised for the First B.Sc. Examination.

Every candidate for a Degree in Science must be a matriculated student of the University of Edinburgh for the year in which he appears for Examination or Graduation.

* For the complete list of Exemptions, see the Edinburgh University Calendar.

II. Examinations.

For the degree of Bachelor of Science there are two examinations, the First B.Sc. Examination, and the Second B.Sc. Examination.

FIRST B.SC. EXAMINATION.

Subjects: (1) Mathematics, (2) Natural Philosophy, (3) Chemistry, (4) Zoology, including Comparative Anatomy, (5) Botany.

The Examination is held twice a year, in April and October. *For dates, see Almanac.* [Fee, £2 2s.]

SECOND B.SC. EXAMINATION.

The Second B.Sc. Examination is divided into the following groups, one of which must be professed by the candidate:—

(*a*) The Mathematical Sciences	Higher Mathematics, Natural Philosophy.
(*b*) The Physical Experimental Sciences	Experimental Physics, Chemistry.
(*c*) The Natural Sciences	Zoology, Botany, Physiology, Geology.

The Examination takes place twice a year, in April and October. *For dates see Almanac.* [Fee, £2 2s.]

A candidate who has passed the First B.Sc. Examination may proceed to the Second after an interval of six months.

DEPARTMENT (B), ENGINEERING.

I. General Regulations.

Candidates must have the qualifications required in Department (A), preceding page.

There are two Examinations for the Degrees of Bachelor of Science in Engineering. Any candidate who has passed the First Bachelor of Science Examination may proceed to the Second after an interval of six months.

FIRST B.SC. EXAMINATION.

This examination is on the general knowledge of the candidate in (*a*) Mathematics, (*b*) Natural Philosophy, (*c*) Chemistry.

The scope of each of these subjects in this Examination is the same as in the First B.Sc. Examination in Department (A).

SECOND B.SC. EXAMINATION.

This Examination is in—

(*a*) Dynamics.
(*b*) Engineering.
(*c*) Drawing.

DOCTOR OF SCIENCE EXAMINATION.

[Fee, £5 5s.]

A candidate who has obtained the Degree of B.Sc., and has completed his 21st year, is admissible to this Examination after an interval of twelve months.

Department A.—Candidates must pass a searching examination in one of the following subjects: 1. Mathematics; 2. Natural Philosophy; 3. Chemistry; 4. Zoology and Comparative Anatomy; 5. Animal Physiology; 6. Botany; 7. Geology, including Palæontology, and Mineralogy. In subjects 1, 2, 3 the Examination is on one principal branch (selected by the candidate) of the subject.

Each candidate must, previous to the Examination, submit a Thesis containing some original researches in the subject of his intended Examination, and such Thesis must be approved before the candidate is allowed to proceed to Examination.

Department B.—Each candidate must prove that he has been engaged for at least two years under an engineer in actual practice, and pass a searching examination in one principal branch of either Practical Engineering or Applied Science.

GRADUATION IN MEDICINE.

Preliminary Examination in General Education.

The Preliminary Examinations in General Education are held in the Examination Hall in the University.

All Candidates are required to enter their names *in full* in a book, kept for the purpose at the Office of the Faculty of Medicine, University New Buildings, and at the same time to mention the subject or subjects in which they offer themselves for Examination. They are also required to state whether they have before appeared for any Preliminary Examinations at this University.

Any Candidate who cannot appear personally at the time fixed to enter his name and pay the fee, can obtain, on application in writing to the Dean of the Faculty of Medicine, University New Buildings, a schedule, which he should fill up and transmit with a *crossed Post Office Order* or *Postal Order*, for the Fee to the *Clerk of the Senatus.*

Students Matriculated for the academic year in which the Examinations take place (*1st October to 1st October*), and who have entered their names at the time required by the Regulations, will be admitted to the Examination without payment of the special fee, but they are required to present their Matriculation Tickets at the entrance to the Examination Hall. Matriculation for 1888-9 will begin on 1st October, and Candidates may Matriculate up to the date of Examination, provided they have entered their names for the Examination at the time stated. Non-Matriculated Students pay a Fee of Ten Shillings each, and are admitted on showing their receipts at the entrance to the Examination Hall. Those who pay the Fee in March will be admitted to the Examination in October without farther payment, on showing their tickets of admission. Payment in October does not exempt from payment in March.

1. In conformity with Section I. of the Statutes, Examinations on the Preliminary Branches of Extra-Professional Education will take place on Tuesday, Wednesday, Thursday, and Friday, the 2nd, 3rd, 4th, and 5th October 1888; and on Tuesday, Wednesday, Thursday, and Friday, the 5th, 6th, 7th, and 8th March 1889.

Examination on Tuesdays.—Arithmetic, 9 to 11 A.M.; Mathematics (Geometry, Algebra), 11.30 A.M. to 1.30 P.M.; Higher Mathematics, 2 to 4 P.M.

Examination on Wednesdays.—English, 9 to 11 A.M.; Natural Philosophy, 11.30 A.M. to 1.30 P.M.; Mechanics, 2 to 4 P.M.

Examination on Thursdays.—Latin, 9 to 11 A.M.; Logic, 11.30 A.M. to 1.30 P.M.; Moral Philosophy, 2 to 4 P.M.

Examination on Fridays.—Greek, 9 to 11 A.M.; French, 11.30 A.M. to 1.30 P.M.; German, 2 to 4 P.M.

SUBJECTS OF EXAMINATION FROM OCTOBER 1888 TO OCTOBER 1890, INCLUSIVELY, EXCEPT IN FRENCH AND GERMAN, WHICH ARE ONLY PRESCRIBED FROM OCTOBER 1888 TO OCTOBER 1889, INCLUSIVELY.

1. *English.*—The Examination will include:—(1.) Writing a passage of English from dictation; (2.) English Composition, with the correction of sentences of bad English; (3.) Questions in English Grammar, with analysis of sentences and the derivation and definition of some common English words; (4) Questions in Geography and History, especially in the History of the British Islands and of English Literature. Candidates who have passed a qualifying Examination either in English (including Grammar, &c.) only, or in History and Geography only, will be allowed to take *separately* the portions in which they have not qualified, provided they give their paper to the Examiner at the end of half of the prescribed time.
2. *Latin.*—For October 1888, Livy, Book XXI. For March and October 1889, Cicero de Senectute. For March and October 1890, Livy, Book XXII. An easy passage from a Latin prose author, and a single passage of English (translated from a Latin author) to be re-translated into Latin—the more difficult Latin words being given.
3. *Arithmetic.*—The Common Rules, including Vulgar and Decimal Fractions.
4. *Elements of Mathematics.*—Geometry, Euclid, Books I., II., and III., or Wilson's *Elementary Geometry*, Books I., II., III., or Books I., II., III. of the Text-Book issued by the Association for the Improvement of Geometrical Teaching (Parts I. and II.). The Elementary Rules of Algebra, including Simple Equations. A knowledge of Geometry alone or of Algebra alone will not be sufficient. Candidates who have passed a qualifying Examination in Geometry only, or in Algebra only, will be allowed to take *separately* the subject in which they have not qualified, provided they give their paper to the Examiner at the end of half the prescribed time.

5. *Elements of Dynamics* (*Mechanics*).—Elementary Kinematics, Statics, Kinetics, and Hydrostatics. Text-Book: Blaikie's *Elements of Dynamics* (excluding the appendix).

II. In conformity with Section II. of the said Statutes, which enacts that no candidate shall be admitted to a professional examination who has not passed a satisfactory examination on at least *two* optional subjects (in addition to the subjects mentioned above), examinations will also take place on the following subjects:—

1. *Greek.*—For October 1888, Xenophon, *Cyropaedia*, Bk. IV. For March and October 1889, Xenophon, *Anabasis*, Book IV. For March and October 1890, Xenophon, *Cyropaedia*, Book II.
2. *French.*—For October 1888, E. Foa, *Contes Historiques*. For March and October 1889, A. de Vigny, *La Canne de Jonc*.
3. *German.*—For October 1888, Hauff, *Jud Suss*. For March and October 1889, G. v. Moser, *Der Bibliothekar*.
4. *Higher Mathematics.*—Geometry, Euclid, Books I.-IV., Book VI., and the Propositions of Book XI., usually given in the modern editions, or Wilson's *Elementary Geometry*, Books I., II., III., V., and Wilson's *Solid Geometry and Conic Sections*, Book IV., Sections I.—Algebra, Elementary Trigonometry, and Conic Sections. Text-Book for Conic Sections, Wilson's *Solid Geometry and Conic Sections*, Book V. The use of the above text-books is not imperative; they are cited merely to indicate the scope of the examination.
5. *Natural Philosophy.*—Text-Book recommended — Balfour Stewart's *Elementary Physics*.
6. *Logic.*—For October 1888, either Fowler's *Deductive Logic*, *Intro.*, Parts I., II. (chaps. i.-iv. and vii., viii.), III. (chaps. i., ii., iii., and viii.), and *Inductive Logic*, chap. i., ii. (§§ 1 and 2), iii., iv.; or Professor Campbell Fraser's *Selections from Berkeley*, Editor's "Introduction" and "Principles of Human Knowledge," Part I., §§ 1-44. For October 1889 to March 1890 inclusively, either Fowler as before or Professor Campbell Fraser's *Selections from Berkeley*, Editor's "Introduction" and "Dialogue on Visual Language," along with the Prefatory Note, pp. 147-153 (3rd edition).
7. *Moral Philosophy.*—For October 1888, Bishop Butler's *Sermons* 1, 2, 3, and Professor Calderwood's *Handbook*, pp. 1-43, 123-152, 165-202. For March and October 1889, (1.) Sidgwick's *History of Ethics*, chap. iv., §§ 1-16 inclusive; (2.) Professor Calderwood's *Handbook*, pp. 1-47, and 77-97. For March and October 1890, Professor Calderwood's *Handbook of Moral Philosophy*, Introduction, Intuitional Theory, chaps. iii. and iv., with chapter on the Will; and Sidgwick's *Outlines of the History of Ethics*, chap. iv., §§ 1-16, inclusive.

In answering the questions in Arithmetic, Mathematics, and Dynamics (Mechanics), the steps of the reasoning, as well as the final result, must be exhibited.

As regards Latin, Greek, French, and German, mere translation is not sufficient. There must be translation of an English passage into each of the languages taken up by the Candidates.

A Degree in Arts in any one of the Universities of the United Kingdom, or in one of the Colonial Universities, or Universities of British India, exempts from the Preliminary Examination.

The Preliminary Examinations in General Education of certain other bodies are recognised *pro tanto* (see Edinburgh University Calendar, p. 342); that is to say, they exempt from examination on the subjects comprised in them, in so far as the examinations are of the same extent as those required by this University. Any subjects required by the Regulations, and not included in these examinations, or not carried out to the requisite extent, must be passed at the University.

Mathematics must in all cases be equivalent in Geometry to at least the first three Books of Euclid.

As regards Optional Subjects, each of them must be certified; and in so far as they are of the nature and extent required by the University, they will be allowed to qualify.

No Examination of any other Board will be received on any subjects in which Candidates have been remitted at this University.

In all cases Candidates must produce Certificates of having passed such Examinations, with an official notice of the subjects *in which they have passed, and of the* extent *of the Examination in each subject.*

In all cases where the Certificates have been granted on the aggregate of the marks obtained by the Candidates the Official Certificate of the percentages in each subject must be produced.

First Professional Examination.

The Faculty of Medicine have resolved that the written and oral examinations on Chemistry, Botany, and Natural History, in July 1889 and March 1890 shall be restricted in the following manner:—

1. *Chemistry.*—Classification of Elements. General Laws of Chemical Combination and Action, as illustrated in the simpler compounds of the more commonly occurring elements.

Symbolic Notation.

Preparation and Properties of the Non-Metallic Elements and their chief Compounds.

Classification and General Properties of Acids, Bases, and Salts—Electrolysis of Salts.

Oxygen, Ozone, Oxidation and Reduction.

Hydrogen, Water, Peroxide of Hydrogen, Chlorine, Hydrochloric Acid, Hypochlorites, Chlorates, Perchlorates, Bromine, Hydrobromic Acid, Bromates, Iodine, Hydriodic Acid, Iodates, Periodates, Fluorine, Hydrofluoric Acid. Sulphur, Sulphuretted Hydrogen, Oxides of Sulphur, Sulphites, Sulphates, Thiosulphates, Chlorides of Sulphur, Chloride of Sulphuryl, Nitrogen, The Atmosphere, Oxides of Nitrogen, Nitrates, Nitrites, Ammonia, Ammonia Salts, Phosphorus, Oxides of Phosphorus, Chlorides and Oxychloride of Phosphorus, Phosphates, Phosphites, Hypophosphites, Boron, Boracic Acid, Borates, Fluoride

of Boron, Silicon, Silica, Silicates, Chloride of Silicon, Fluoride of Silicon, Hydrofluosilicic Acid.

Carbon, Oxides of Carbon, Carbonates, Phosgene. Classification of Carbon Compounds. Marsh Gas and its Homologues. Chloroform. Methylic and Ethylic Alcohols and Ethers. Methylamine, Dimethylamine, Trimethylamine, Tetramethylammonium. Formic and Acetic Acids, Aldehyde, Acetone, Chloral, Olefiant Gas, Glycol, Oxalic Acid, Lactic Acid. Tartaric Acid, Citric Acid. Fats and Oils, Saponification, Glycerine. Cellulose, Sugars, Starch. Products of Distillation of Wood and of Coal. Coal-Gas, Coal-Tar. Turpentine, Camphor. Benzene, Benzoic Acid, Salicylic Acid, Oil of Bitter Almonds. Hydrocyanic Acid, Cyanides, Cyanates, Thiocyanates, Urea.

The following metals, their Oxides, Sulphides, and more important Salts. Potassium, Sodium, Magnesium, Calcium, Strontium, Barium, Aluminium, Zinc, Cadmium, Manganese, Chromium, Iron, Nickel, Cobalt, Bismuth, Lead, Copper, Mercury, Silver, Tin, Gold, Platinum, Antimony, Arsenic.

Simple Qualitative Analysis. [*The Examination in Analysis is conducted practically.*]

2. *Botany.*—The characteristic features of the following groups and classes of the vegetable kingdom :—

Thallophyta [Schizopyta, Algæ, Fungi]; Muscineæ [Hepaticæ, Musci]; Pteridophyta [Filicinæ, Equisetineæ, Lycopodineæ]; Phænerogamæ [Gymnospermæ, Angiospermæ (Monocotyledones, Dicotyledones)].

The fundamental facts of Morphology (including Anatomy, Histology, and Development) and Physiology as they are illustrated in the life-history of the following plants :—Bacterium, Saccharomyces, Mucor, Vaucheria, Eurotium, Funaria, Aspidium, Pinus, Scilla, Helianthus.

At the oral examination Candidates may also be questioned regarding Ulmus, and required to demonstrate, the characters of plants belonging to the following natural orders of Phanerogamæ :—Coniferæ, Gramineæ, Orchideæ, Liliaceæ, Urticaceæ, Labiatæ, Compositæ, Umbelliferæ, Rosaceæ, Leguminosæ, Cruciferæ, Ranunculaceæ.

3. *Natural History.*—(*a.*) The Principles of Classification.

(*b.*) The distinctive characters of the more important Groups of the Invertebrata, together with a knowledge of the general structure of the following forms :—Hydra, Lumbricus, Hirudo, Anodon, Helix, and Nephrops, and of the appendages of Scorpio and Periplaneta.

(*c.*) The distinctive characters of the Chordata.

(*d.*) A general knowledge of the orders included in the groups Pisces and Mammalia.

(*e.*) A general knowledge of the following animals, viz. :—Phallusia, Amphioxus, Myxine, Raia, and Gadus; Rana, Columba, Ornithorhynchus, Macropus, Lepus, Ovis, and Canis; and of the skeleton of

Crocodilus, Equus, Felis, Balæna, Vespertilis, and Troglodytes gorilla.

(*f.*) The maturation, segmentation, &c., of holoblastic and meroblastic ova, the formation of the embryonic layers; the more important facts concerning the development of *Hydra*, *Amphioxus*, *Scyllium*, and *Rana*, and the origin of the fœtal appendages of Lepus.

(*g.*) The principles of Geographical Distribution of Animals and a general knowledge of the Distribution of the Mammalia.

The oral examination will be confined to the forms in (*b*), (*e*), and to those printed in italics in (*f*).

"Students who profess themselves ready to submit to an examination in these subjects may be admitted to examination therein at the first period of examination after they have completed their attendance on the necessary classes; provided always that it shall be lawful for students to proceed to examination in the said subjects under the following alternative subdivisions, namely—(*a*) Botany and Natural History, (*b*) Chemistry (including Practical Chemistry), (*c*) Botany and Chemistry (including Practical Chemistry), or (*d*) Natural History and Chemistry (including Practical Chemistry), at the first period of examination after they have completed attendance on the relative classes; and to proceed to examination in the remaining subject or subjects at a subsequent period of examination."

Honours at Professional Examinations.

Candidates who have displayed special merit at any of the Professional Examinations will be announced as having passed that Examination "with distinction."

Candidates who have displayed special merit at each of the three Professional Examinations will be announced, at the time of the Graduation, as having obtained First or Second Class Honours, according to the merit that had been displayed.

For further information the Calendar of the Edinburgh University should be consulted.

UNIVERSITY OF OXFORD.

EXAMINATIONS OPEN TO WOMEN WITHOUT RESIDENCE.

Attention is directed to a Statute of the University of Oxford recently passed, by which women who have passed the First Examination for Women, or any of the examinations specified in the Regulations of the Oxford University Examinations for Women as equivalent thereto, may, without the obligation of residence, offer themselves for the Honour Examinations of the University in Greek and Latin, in Mathematics, in Modern History, or in Physical and Natural Science.

Candidates who so offer themselves will be examined by the University Moderators or Public Examiners (as the case may be) in the same papers and at the same time, and will be classed according to the same standard as members of the University, and may receive certificates to that effect. Full particulars as to these examinations will be found in the Regulations for 1889—Oxford University Examination for Women. All communications should be addressed to H. T. GERRANS, Esq., Local Examinations Office, Oxford.

CIVIL SERVICE EXAMINATIONS.

HOME CIVIL SERVICE. *Higher Division.*

This branch of the Civil Service is the most attractive, and offers the most lucrative posts.

The number thrown open to competition every year is from ten to twenty ; the limits of age for Candidates are from 18 to 24.

The subjects are the same as those given below for the Indian Civil Service, but the papers are more advanced, and the distribution of marks somewhat different.

A three or four years' training would not be too much to expend in preparing for this examination, and excellence in one or two subjects should be preferred to a general knowledge of several.

INDIAN CIVIL SERVICE.

The examination is held annually, in June. The number of posts to be filled up is variable, but may be stated on the average as forty. The limits of age are 17 and 19.

The subjects are :—

English Composition	Marks,	300
English History		300
English Literature		300
Greek		600
Latin		800
French		500
German		500
Italian		400
Mathematics (*Pure and Mixed*) ...		1000
Natural Science (two branches) ...		800
Logic		300
Political Economy		300

The successful Candidates remain for two years in England under probation, which period must be passed at some University or College, and the Candidate must acquit himself satisfactorily at periodical examinations. At the last of these examinations his position in the order of merit will determine his seniority in the Indian Civil Service.

During the period of probation an allowance of £300 is given to all selected Candidates who satisfy the Commissioners at the periodical examinations.

To enter for this examination with a good chance of success, three years, from 15 to 18, should be spent in attending classes at University College. A candidate should be strong in two or three subjects at least—Mathematics, English, and Latin being especially useful.

Intending Competitors are recommended to read a pamphlet on "The Indian Civil Service as a Career for Scotsmen," by J. Wilson, M.A. Edinburgh : David Douglas.

Examination Papers.

ENTRANCE EXAMINATION FOR DAY STUDENTS UNDER SIXTEEN.

ENGLISH GRAMMAR AND COMPOSITION.

1. State, with examples, the different ways in which the plurals of substantives are formed.
2. Give examples—(1) of nouns that have no singular; (2) of nouns that have no plural; (3) of nouns that have two plurals; and (4) of nouns that have the singular and plural alike.
3. How are (1) sentences and (2) clauses divided in analysis? Indicate the peculiarity of each kind of sentence and clause; and illustrate your answer by *examples*.
4. Write two paragraphs on the "Invention of Printing."

T. G.

ARITHMETIC.

1. Prove that two-thirds of four-fifths are equal to eight-fifteenths. Simplify $\frac{1}{2}+\frac{1}{3}$ of $\frac{1}{4}-5\frac{1}{2}\times\frac{1}{11}$.
2. Extract the square root of ·15129.
3. The discount on a sum of money for 8 months at 4 per cent. is £5 6s. 8d. Find the sum.
4. Divide £333 amongst 7 men, 3 women, and 10 boys, so that each man may have as much as a woman and a boy, and three boys as much as one man.

J. E. A. S.

LATIN—GENERAL PAPER.

1. Decline fully tussis, Aeneas, vis, alius.
2. Give comparative and superlative of malus, facile, nequuam, superus.
3. Give the 1st person, perfect active, present infinitive, and supine of lavo, maneo, gaudeo, bibo, gero, gemo, ferio, venio.

4. Translate into Latin :—

We must not envy those who are more fortunate than ourselves.

He asked me for money, when he was himself wealthy.

Do you ask me when I left Rome?

5. Give a short sketch of the 2nd Punic War, or of the life of Julius Cæsar.

FRENCH.

Thursday, 4th October 1888.—2 to 4 p.m.

I. Translate into English :

MIRABEAU.

Le plus audacieux des chefs populaires, celui qui, toujours en avant, ouvrait les délibérations les plus hardies, était Mirabeau. Les absurdes institutions de la vieille monarchie avaient blessé des esprits justes et indigné des cœurs droits ; mais il n'était pas possible qu'elles n'eussent froissé quelque âme ardente et irrité de grandes passions. Cette âme fut celle de Mirabeau, qui, rencontrant dès sa naissance tous les despotismes, celui de son père, du gouvernement et des tribunaux, employa sa jeunesse à les combattre et à les haïr. Il était né sous le soleil de la Provence, et issu d'une famille noble. De bonne heure il s'était fait connaître par ses désordres, ses querelles et une éloquence emportée. Ses voyages, ses observations, ses immenses lectures, lui avaient tout appris, et il avait tout retenu. Mais outré, bizarre, sophiste même quand il n'était pas soutenu par la passion, il devenait tout autre par elle. Promptement excité par la tribune et la présence de ses contradicteurs, son esprit s'enflammait : d'abord ses premières vues étaient confuses, ses paroles entrecoupées, ses chairs palpitantes ; mais bientôt venait la lumière : alors son esprit faisait en un instant le travail des années ; et à la tribune même, tout était pour lui découverte, expression vive et soudaine.

THIERS.

II. GRAMMAR PAPER.

1. *Audacieux.*—Give the feminine of *audacieux* and the masculine and feminine of the adjectives in *x*, which form their feminine irregularly.

2. *Vieille.*—Give the two masculine forms of this and of the other adjectives which have two forms for the masculine.
3. *Les plus hardies.*—When is *le* variable and when invariable before *plus?*
4. *Employa, combattre, haïr, né, issu.*—Give the primitive tenses of these verbs.
5. *Il s'était fait connaître.*—Explain the concord of *fait.*

III. Translate into English :

A LA FORTUNE.

Fortune, dont la main couronne
Les forfaits les plus inouïs,
Du faux éclat qui t'environne
Serons-nous toujours éblouis ?
Jusques à quand, trompeuse idole,
D'un culte honteux et frivole
Honorerons-nous tes autels ?
Verra-t-on toujours tes caprices
Consacrs par les sacrifices
Et par l'hommage des mortels ?

J. B. ROUSSEAU.

IV. Translate into French :—

Either the well was very deep, or she fell very slowly, for she had plenty of time as she went down to look about her, and to wonder what was going to happen next. First, she tried to look down and make out what she was coming to, but it was too dark to see anything ; then she looked at the sides of the well, and noticed that they were filled with cupboards and book-shelves : here and there she saw maps and pictures hung upon pegs. She took down a jar from one of the shelves as she passed ; it was labelled "Orange Marmalade," but to her great disappointment it was empty : she did not like to drop the jar for fear of killing somebody underneath, so managed to put it into one of the cupboards as she fell past it.

"Well !" thought Alice to herself, "after such a fall as this, I shall think nothing of tumbling down stairs ! How brave they'll all think me at home ! Why, I wouldn't say anything about it, even if I fell off the top of the house." (Which was very likely true.)

Alice's Adventures in Wonderland.

ARMITSTEAD (ENTRANCE) SCHOLARSHIPS.

Wednesday, 3rd October.—9—11.45.

LATIN—TRANSLATION AND COMPOSITION.

I. Translate into Latin :—

Hercules therefore went on board a ship, and, having obtained suitable weather, set sail at once. When he arrived in Libya, he landed immediately, and betook himself to a town, which was not far off. Although, however, he inquired of all the inhabitants, he could not learn in what region the garden of the Hesperides was situated. At length, after he had travelled a whole year, he reached a distant land, in which there dwelt a certain man named Atlas. Here Hercules determined to remain a few days, in order to take rest after so great a journey. Now Atlas was a man of such size of body that he held up the heavens on his shoulders. When Hercules saw him he wondered greatly, and determined to ask his help.

II. Translate :—

HERO AND LEANDER.

Nox erat incipiens (namque est meminisse voluptas)
Cum foribus patriis egrediebar amans.
Nec mora, deposito pariter cum veste timore,
Jactabam liquido bracchia lenta mari.
Unda repercussae radiabat imagine lunae
Et nitor in tacita nocte diurnus erat:
Nullaque vox nostras, nullum veniebat adures,
Praeter dimotae corpore, murmur, aquae.
Jamque fatigatis umero sub utroque lacertis,
Fortiter in summas erigor altus aquas.
Ut procul aspexi lumen, meus ignis in illo est;
Illa meum, dixi, litora numen habent.
Et subito lassis vires rediere lacertis,
Visaque, quam fuerat, mollior unda mihi.
Quo magis accedo, propioraque litora fiunt,
Quoque minus restat, plus libet ire mihi.

W. P.

LATIN—GENERAL PAPER.

Wednesday, 3rd October 1888.—12—1.30.

1. Give the genitive singular, gender, and meaning of—carcer, vicus, calx, aries, socer, lac, scelus, merces, imber, nemus.

2. Give the perfect, supine, present infinitive, and meaning of—sperno, torqueo, tundo, juvo, occulo, sono, sterno, figo, verto, cupio.

3. State and exemplify, as fully as you can, the rules for the expression in Latin of (*a*) Place *whither*, place *whence*, place *where*; and (*β*) time *when*, time *how long*.

4. Compare the Latin participial system with the English, and give examples showing how its defects are supplied.

5. State the rule for the sequence of tenses in final and consecutive clauses. Give examples.

6. What constructions are used with *impero*, *interest*, *vereor*, *quin*, *dum*, *jamdudum*? Illustrate by examples.

7. Distinguish between *num* and *nonne*; *quŏque* and *quōque*; *vires* and *ovri*; *alter* and *alius*; *uter* and *uterque*.

8. Explain the following terms:—Inceptive or Inchoative verb, predicative dative, oratio obliqua, gerundive, attraction, deponent verb.

9. Turn into Latin:—(*a*) He was the first to go away; (*b*) he hopes to have a prosperous voyage; (*c*) he said that he had sent no one; (*d*) he did not even spare his son; (*e*) Gaius promised to show me the house to-morrow.

10. Name six of the most important battles in Roman history, and give a *very short* account of the circumstances of each.

W. P.

ENGLISH.

Wednesday, October 3.—3—5.30 p.m.

1. What foreign elements are to be found in English? Illustrate your answer by examples.

2. Give Morris's classification of pronouns; and trace the history of *any one* class.

3. Relate briefly the history of the Norman Conquest; and mention the chief changes it caused in England.

4. Give a short account of the reign of Queen Anne.

5. Either (1) write a life of Chaucer, and give some account of the "Canterbury Tales"; or (2) write a life of Spenser, and give some account of the "Faery Queene."

6. Draw out as full a list as you can of the leading English prose writers in the Eighteenth Century; and name *one* work by each author you mention.

7. Write a short essay on "The Newspaper Press."

T. G.

October 1888

MATHEMATICS I.

N.B.—Candidates for the Entrance Scholarships and the Smart Bursary will work Questions 1 to 9 inclusive.

Candidates for the Second Year Scholarships will work Questions 4 to 12 inclusive.

1. Define a circle, a right angle, and a square.
   Prove that any diameter bisects a circle.

2. The exterior angle of a triangle is greater than either of the two interior opposite angles.
   When is it greater than the remaining angle also?

3. Explain the two usual methods of measuring an angle.
   Through what angle does the earth turn in an hour?

4. Construct a parallelogram equal to a given triangle and having an angle equal to a given angle.

How many such parallelograms can you obtain by your construction?

5. If a straight line be divided into two parts, the square on the whole line is equal to the sum of the squares in the parts together with twice the rectangle contained by the parts.

Enunciate and prove the corresponding proposition when the straight line is divided into any number of parts.

6. If two circles meet they cannot have the same centre.

Two circles cannot meet in more points than two.

7. Define equal ratios and prove that angles at the centre of a circle are proportional to the arcs on which they stand.

8. Prove by a geometrical construction that

$$\sin 2A = 2 \sin A \cos A,$$

and hence shew that

$$\sqrt{(1 + \sin 2A)} = \sin A + \cos A,$$
$$\sqrt{(1 - \sin 2A)} = \sin A - \cos A;$$

and deduce the sine and cosine of $15°$.

9. The sides of a triangle are $\sqrt{3} - 1$, $\sqrt{3} + 1$, and the angle opposite the smaller side is $15°$; solve the triangle.

10. Find the locus of points whose distances from two fixed points are in a constant ratio; and shew what it becomes when this ratio is one of equality.

11. ABCD is a quadrilateral inscribed in a circle; $AB = a$, $BC = b$, $CD = c$, $DA = d$, $AC = x$; prove that

$$x^2 (ab + cd) = (ac + bd)(ad + bc).$$

12. Prove that $1 + \cos 5A = (1 + \cos A)(1 - 2 \cos A + 2 \cos 2A)^2$.

J. E. A. S.

October 1888

MATHEMATICS II.

N.B.—Candidates for the Entrance Scholarships and the Smart Bursary will work Questions 1 to 9 inclusive.

Candidates for the Second Year Scholarships will work Questions 4 to 12 inclusive.

1. The simple interest on a sum of money for two years is £2 1s. 8d.; and the compound interest for the same time is £2 2s. 6d. Find the sum and the rate per cent.

2. Prove by as simple a method as possible that
$$\frac{x^{12}-x^9+x^6-x^3+1}{x^4-x^3+x^2-x+1}=\frac{x^{10}-x^5+1}{x^2-x+1}.$$

3. Find the factors of $(x+2y+3z)^2-(3x+2y+z)^2$, and of
$$a^2(b-c)+b^2(c-a)+c^2(a-b).$$

4. Explain the method for contracting multiplication when only an assigned number of significant figures in the product is needed. As an example multiply together 3·14159 and 2·71828 so as to retain 6 significant figures.

5. Solve the equations:—
(1) $\frac{2}{x+3}+\frac{3}{2x-4}=\frac{7}{2x}$;
(2) $\sqrt{(x^2+3x+10)}+\sqrt{(x^2+3x-5)}=15$;
(3) $x^2+xy+y^2=91$,
$x^2-xy+y^2=31$.

6. Define ratio, a ratio of greater inequality, duplicate ratio.
Which ratio is the greatest, and which the least of the three ratios—
$$\sqrt{2}:\ 1,\ 17:12,\ 41:29?$$

7. In what case can the square root of a binomial surd, $a+\sqrt{b}$, be expressed in a simple form?
Find the values of the square roots of $26+4\sqrt{30}$, and of
$$2a+b+2\sqrt{(a^2+ab)}.$$

8. Define the Arithmetic, Geometric, and Harmonic mean between two quantities. Find those between 3 and 12.
9. Three men work consecutively at a piece of work which they finish in 10 days, by A giving 3 days, B 2 days, C 5 days to it. If, however, A had given 4 days, B 1½ days, C 4 days, it would have been done; and if A had given 2 days, B 3 days, C 5½ days it would have been done. How long would each have taken separately?
10. In dividing a number N by another number n the quotient is q and the remainder r. Write down the equation connecting N, n, q, r; and shew that the remainders left in dividing N^2 and r^2 respectively by n are identical.
11. Find the square root of $1+2x+3x^2+4x^3$ as far as x^3 and give the remainder.
12. What is variation? If A varies as B when C is constant, and as C when B is constant, prove that when B and C both vary, A varies as BC. Give a geometrical illustration.

J. E. A. S.

October 1888

SMART BURSARY

NATURAL PHILOSOPHY

1. State Newton's three laws of motion, giving two examples of each.
2. Prove that if two bodies moving in the same straight line come into collision the total momentum is unaltered. What happens to the energy?
3. State the laws of friction, and explain how they may be verified experimentally.
4. Give Boyle's law, and notice the character of gases which deviate most from it.
5. Distinguish between a noise and a musical note; between a simple note and a chord.

6. Give the laws of refraction, and explain the phenomenon of total reflexion.
7. Describe the manufacture of an ordinary thermometer, and state on what hypothesis it is graduated.
8. Describe the curves obtained by shaking filings of steel over a sheet of paper under which a bar magnet is placed, first, longitudinally; second, end on.
9. Explain how the capacity of a condenser is increased by bringing its plates nearer.

J. E. A. S.

CHEMISTRY.

October 3rd, 1888.

1. A given gas or mixture of gases answered to the following tests, what was the qualitative and quantitative composition of the gas?—
   (*a*) On the application of a light it burnt with a bright luminous flame.
   (*b*) On shaking up the original gas with an excess of lime-water, a milky precipitate was produced, and one-fifth of the volume of the gas was absorbed.
   (*c*) The residual gas on the application of a light still burnt with a luminous flame.
   (*d*) On shaking up the residual gas from *b* with strong sulphuric acid one-half of the gas was absorbed, and the unabsorbed portion burnt with a non-luminous flame, and the product of the combustion was completely absorbed by lime-water with the formation of a milky precipitate.
2. A current of sulphurated hydrogen is passed through neutral solutions of copper sulphate, arsenic trichloride, ferric chloride, and zinc chloride respectively, and then caustic soda solution, added in excess to each, and warmed, state what would be the result in each case, and give equations. What would have been the effect had hydrochloric acid been used instead of caustic soda?

3. What is the action of water on the several oxides of nitrogen? Nitrogen tetroxide is sometimes represented by NO_2 and sometimes by N_2O_4. Is only one or both of these correct? Explain your answer, and describe an experiment or experiments in support of it.

4. How would you prove that red and yellow phosphorus were modifications of one and the same element phosphurus? How could you convert the one form into the other, and *vice versa?* In what does the real difference between them most probably consist, giving reasons for your answer?

5. Describe what you think is the best method for softening hard-water, and explain fully how you would apply it on the large scale for bleaching purposes. Mention any disadvantages which the method may have, and state any special advantages it may possess over other processes.

T. C.

BIOLOGY.

3rd October 1888.—12 to 1.30 p.m.

1. What are commonly considered to be the chief distinctions between animal and vegetable life?

2. What are the special lessons that we attempt to illustrate by the following types:—Yeast, fern, amoeba, hydra, crayfish.

3. Mention some of the general lessons that we learn from a study of the geographical distribution of animals.

D. W. T.

SMART BURSARY IN ENGINEERING.

DRAWING.

I.

Draw from Measurement a Half Elevation and Section combined of the Connecting-Rod End supplied. Scale full size.

II.

(*Five Questions to be answered.*)

1. Bisect the angle between two lines, the intersection of which is unavailable.
2. Given two lines 4″ long, making an angle of 30° with each other, draw a series of circles touching each other and the lines.
3. Given three points 2″, 3½″, and 5″ apart, draw a circle passing through the points, without using the centre.
4. Draw the plan and elevation of a hexagonal nut 2″ across corners, and 1¾″ deep.
5. Draw the involute of a circle 1″ diameter.
6. Draw the plan and elevations of the four vertical faces of the rectangle given you, when one end rests on the horizontal plane.

J. A. E.
T. R.

DAY CLASSES

June, 1889

JUNIOR MATHEMATICS

I.

1. The exterior angle of a triangle is greater than either of the interior opposite angles.

   From the same point it is impossible to draw two perpendiculars to a given straight line.

2. Parallelograms on the same base and between the same parallels are equal.

   Prove that two such parallelograms can always be so divided as to be capable of superposition.

3. The complements of the parallelograms that are about the diagonals of a parallelogram are equal.

   ABCD is a parallelogram. HOK, LOM are drawn parallel to the sides AB, BC, meeting AB, BC, CD, DA in L, H, M, K respectively and making the parallelograms ALOK, CHOM equal. Prove that B, O, C are collinear.

4. If a straight line be divided into two equal and also into two unequal parts, the sum of the squares on the unequal parts is equal to twice the sum of the squares on half the line and on the part between the points of section.

   Find the locus of a point the sum of the squares of whose distances from two given points is constant.

5. Prove that a line perpendicular to a radius of a circle at its extremity P touches the circle, and that every other line through P meets the circle again.

   If Q be taken on the circle, prove that PQ produced approaches indefinitely near to the tangent at P as Q approaches indefinitely near to P.

6. The opposite angles of a quadrilateral inscribed in a circle are together equal to two right angles.

ABCD is a quadrilateral inscribed in a circle; BA, CD meet in P; CB and DA in Q. Prove that if a circle can be described round PDBQ, AC is a diameter of the first circle.

7. If a point be taken outside a circle and a tangent drawn from it to the circle, and also a line to cut the circle, prove that the square on the tangent is equal to the rectangle contained by the two segments of the other line.

Two circles intersect in A, B: what is the locus of a point P such that the tangents from P to the circles are equal?

8. If two triangles have two sides of one proportional to two sides of another, and the contained angles equal, prove that the triangles are equiangular, and the sides about the other angles are proportional, those sides which are opposite to equal angles being homologous sides.

ABCD is a parallelogram formed by rods pointed at A, B, C, D: in BC a point P is taken, and in DC produced a point Q such that CQ : AB = PC : BP. Prove that if A is kept fixed A, P, Q are in one straight line, and AQ : AP is a fixed ratio. What practical application can be made of this result?

9. Define duplicate ratio, and prove that if two ratios are equal, the duplicate ratios of these ratios are also equal.

Similar triangles are in the duplicate ratio of their homologous sides.

10. Give rules for ascertaining the divisibility or not of numbers by 4, 5, 9, 11. Find the factors of 27401.

If the sum of the two numbers formed by the first three digits and the last three digits of a number of six figures is divisible by 37, so is the whole number. Prove this.

J. E. A. S.

JUNIOR MATHEMATICS

II.

1. Prove that if a, b, c are whole numbers, a times b = b times a; and hence show that $abc=bca=cab=acb=cba=bac$, pointing out exactly the axiom introduced in the second part of the proof.

2. Multiply together by any method the four quantities $a+b+c$, $a+b-c$, $b+c-a$, $c+a-b$: and divide $(x-y)^5+(y-z)^5+(z-x)^5$ by $(x-y)(y-z)(z-x)$ by any method.

3. Prove that, if we define multiplication of the fraction a/b by the fraction c/d by the statement

$$\frac{a}{b} \times \frac{c}{d} = \frac{a}{b} \text{ of } \frac{c}{d},$$

our definition applies to the case when a/b is an integer.

4. Resolve into factors $x^2-3x-28$, $3x^3-27xa^2$, $x^4+a^2x^2+a^4$, $x^3+3x+3y+y^3$.

5. Find the H.C.F. of x^5+11x^3-54 and $x^5+11x+12$; and the L.C.M. of x^3+x^2-4x-4, x^3+2x^2-x-2, x^3-2x^2-x+2, and x^3-x^2-4x+4.

6. Solve the equations

(i.) $(x+3)(x+5)(x+7) = (x+2)(x+4)(x+9)$;

(ii.) $\dfrac{2}{x+1}+\dfrac{1}{x+2}=\dfrac{3}{x+3}$;

(iii.) $\dfrac{a+b}{x+y}+\dfrac{a-b}{x-y}=\dfrac{b}{a}+\dfrac{a}{b}$,

$$\frac{x+y}{x-y}=\frac{a}{b}.$$

7. Explain the process for extracting the cube root of an algebraic quantity: find the cube root of $x^6+6x^5-40x^3+96x-64$.

8. When are four algebraic quantities said to be proportional?

There is an alloy of copper and zinc such that if an ounce of zinc is replaced by an ounce of copper the percentage of copper in the whole is increased by five, while the quantity of copper is increased by six and a quarter per cent. What are the quantities of each metal in the alloy?

9. Solve the equations

(i.) $(x+a)(x+b)(x+c) = x^3$;

(ii.) $(ax+y)^2+(ay-x)^2=\frac{1}{2}(a^2+1)^2$,

$$x+y=a$$

10. What is an arithmetical progression? Shew how to sum an arithmetical progression to n terms.

How many terms of the progression 25, 23, 21, . . . are required to have a sum equal to 144?

J. E. A. S.

INTERMEDIATE MATHEMATICS

March 1889

I

1. What is a series? What is a convergent series?
   Sum the series

   (i) $1 + 2x + 3x^2 + \ldots + nx^{n-1}$;

   (ii) $(\sqrt{3} + \sqrt{2}) + 1 + (\sqrt{3} - \sqrt{2}) + (5 - 2\sqrt{6}) + \ldots$
   to an infinite number of terms.

2. Shew that the number permutations of n things r at a time is
   $$\frac{\lfloor n}{\lfloor n - r}$$
   Hence deduce the number of permutations of n things altogether, when p are alike, q others are alike, etc.
   Prove from elementary principles that the number of permutations of n things of which r are of one kind, and the rest of another is equal to the number of combinations of n things r at a time.

3. State the steps of the reasoning by which the Binomial Theorem for a fractional index is deduced from the theorem for an integral index.
   Prove that if x is less than unity the series for $(1 + x)^n$ is always convergent, and find its greatest term when n is positive and not integral.

4. Define a logarithm, and explain exactly the advantage of selecting *ten* as a base.
   If $\log 6 = a$, $\log 15 = b$, $\log 10 = c$, find the logarithms of 4, 27, and 3125.

5. Prove by considering the identity
   $$\left\{\left(1 + \frac{1}{n}\right)^n\right\}^x = \left(1 + \frac{1}{n}\right)^{nx},$$
   or otherwise, that a quantity ϵ exists whose xth power is given by
   $$\epsilon^x = 1 + x + \frac{x^2}{1.2} + \frac{x^3}{1.2.3} + \ldots$$
   Hence deduce $\log (1 + x)$ to base ϵ.

6. Prove that the medians of a triangle meet in a point, and that the sum of their squares is three-fourths the sum of the squares of the sides of the triangle.

7. Define the nine-points circle, and prove its fundamental property.
A triangle has a fixed base and a given vertical angle. Find the ocus of its orthocentre and of the centre of its nine-points circle.

8. P, Q, R are three points on the sides BC, CA, AB, of a triangle; prove that AP, BQ, CR pass through a point if BP. CQ. AR = PC. QA. RB; and PQR lie on a straight line if

$$BP.\ CQ.\ AR = CP.\ AQ.\ BR;$$

attention being paid to sign.

9. If a straight line is perpendicular to each of two straight lines where they meet, prove that it is perpendicular to the plane in which they lie.

10. If two straight lines which meet are parallel to two other straight lines which also meet, the angle between the first pair is equal to that between the second.
How does this proposition enable us to define the angle between two straight lines which do not meet?

11. Prove that parallelepipeds on equal bases and of the same height are equal in volume, and are thrice the pyramids on equal bases and of the same height.

12. Find the area of a sphere.
A sphere is inscribed in a right cone whose angle is 60°: find the ratio of the areas of the sphere and the curved part of the cone.

J. E. A. S.

INTERMEDIATE MATHEMATICS

March 1889

II

1. Define the cosine of an angle and shew that the formula $2n\pi \pm \alpha$ includes all the angles whose cosines are equal to $\cos \alpha$.

2. Prove that

$$\sin 2\theta = 2 \sin \theta \cos \theta$$
$$\cos 2\theta = \cos^2\theta - \sin^2 \theta$$

Find the limiting value of $\cos \theta \cos \frac{\theta}{2} \cos \frac{\theta}{4}$

$$\cos \frac{\theta}{2^n} \text{ when } n \text{ is infinite.}$$

3. Shew that if θ is acute $\sin \theta$, θ, $\tan \theta$ are in ascending order of magnitude, and hence deduce that $\sin \theta < \theta > \theta - \frac{\theta^3}{4}$. What may the value of θ be in order that $\sin \theta$ may differ from θ by not more than ·00001?

4. Shew how to solve a triangle having given b, c, A; and obtain a formula for a adapted to logarithmic computation.

5. Solve generally the equations

$$\begin{aligned} &\text{(i)} \quad \sin \theta + \sin 3\theta + \sin 5\theta = 0; \\ &\text{(ii)} \quad \tan x + \tan y = 7, \\ &\qquad \cot (y - x) = 13. \end{aligned}$$

6. Explain why in finding the ratios of a submultiple of a given angle we get several results generally.

Take for example

$$\cos 4\theta = \cos 4a$$

and solve this equation by the quadratic in $\cos^2\theta$, given by expanding the cosines of 4θ and $4a$

$$8 \cos^4\theta - 8 \cos^2\theta + 1 = 8 \cos^4 a - 8 \cos^2 a + 1.$$

7. Shew that every equation in co-ordinate geometry represents a curve, and trace the curves

$$r^3 = a^3 \cos 3\theta,$$
$$r^3 \cos 3\theta = a^3.$$

What is the connection between them?

8. Prove that the equation

$$ax + by + c = 0$$

always represents a straight line, and that it may be always reduced to the form

$$x \cos a + y \sin a - p = 0.$$

9. Shew how to find the angle between two straight lines given in rectangular co-ordinates. If $ax^2 + 2hxy + by^2 = 0$ be two such lines, find the angle between them in terms of a, h, b.

10. Find the general equation of a circle, and prove that the locus of points whose co-ordinate are given by

$$x = h + a\cos\theta,\ y = k + a\sin\theta$$

is a circle.

11. Find the tangent to the circle $x^2 + y^2 = a^2$, and prove that it may be written in the form $x\cos\theta + y\sin\theta = a$.

If this be called the tangent at the point θ, what is θ? and what is the equation to the chord through θ, ϕ?

J. E. A. S.

FIRST EXAMINATION FOR THE B.Sc. DEGREE OF THE UNIVERSITY OF ST ANDREWS

April 1889

PHYSICAL LABORATORY

WRITTEN EXAMINATION

1. Describe exactly how a vernier would be divided to read thousandths of an inch on a scale divided to fortieths.
2. What are the corrections made in finding the specific heat of a given body?
3. How, and why, is a collimator adjusted when the angle of a prism is to be measured?

PRACTICAL EXAMINATION

Three questions to be tried: one in each group.

A

1. Find the specific gravity of Mercury.
2. Measure the area of the given curve by the planimeter.
3. Find the coefficient of torsion of the given wire.
4. Find the period of the given pendulum for lengths at six suitable intervals from six inches to six feet.

B

1. Find the focal length of the given convex lens by two methods.
2. Obtain the refractive index of the material of the given prism.
3. Find the magnifying power of the given lens with the object at a distance of one foot.

C

1. Find the latent heat of steam.
2. Determine the co-efficient of expansion of iron.
3. Determine the thermal capacity of the given copper vessel.

J. E. A. S.

FINAL EXAMINATION FOR THE B.SC. DEGREE OF THE UNIVERSITY OF ST ANDREWS

April 1889

PHYSICAL LABORATORY

WRITTEN EXAMINATION

1. Explain carefully the adjustments required in using the cathetometer.
2. What is the advantage of using two verniers in reading a graduated circle?
3. Describe the manner in which a box of shunts is used with a galvanometer.

PRACTICAL EXAMINATION

1. Find the coefficient of rigidity of steel by means of the Maxwell's vibration needle.
2. Obtain the period of the given tuning fork by the resonance of the stretched wire.
3. Find the resistance of the gravity battery by Mance's method; and also by some other method.
4. Find the specific resistance of the material composing the given samples of wire.
5. Determine and plot to scale the variation of the intensity of the magnetic field along the axis of the given bar magnet.

J. E. A. S.

June 1889

SENIOR MATHEMATICS

1. Prove that $(\cos\theta + \sqrt{-1}.\sin\theta)^n = \cos n\theta + \sqrt{-1}.\sin n\theta$ when n is a positive integer; and illustrate the proof by a geometrical construction.

2. Find the real quadratic factors of $x^{2n} - 2x^n \cos n\theta + 1$, and deduce the factors of $\sin n\theta$ when n is odd.

3. Using the result in question 2, or by any other method, prove that

$$\sin\theta = \theta\left(1-\frac{\theta^2}{\pi^2}\right)\left(1-\frac{\theta^2}{4\pi^2}\right)\left(1-\frac{\theta^2}{9\pi^2}\right)\ldots;$$

and hence shew that

$$\frac{\pi^2}{6} = 1 + \tfrac{1}{4} + \tfrac{1}{9} + \tfrac{1}{16} + \ldots$$

4. Define a spherical triangle, and state the limitation generally imposed upon its sides.

Shew that the angles of the polar triangle are $\pi - a$, $\pi - b$, $\pi - c$; and the sides $\pi - A$, $\pi - B$, $\pi - C$.

Hence prove that the three angles of a spherical triangle are together greater than two right angles.

5. Prove that in a right angled triangle

$\cos c = \cos a \cos b$, $\tan c \cos A = \tan b$, $\cos c = \cot A \cot B$.

If O be the middle point of the side AB of a spherical triangle with a right angle at C, prove that

$2 \sin OC \cos \tfrac{1}{2} c = \sqrt{(\sin^2 a + \sin^2 b)}$; and hence deduce the corresponding result for a plane triangle, namely that $2\,OC = c$.

6. Prove the relation

$$\cos C + \cos A \cos B = \cos c \sin A \sin B.$$

If in a triangle the side c is a quadrant, then

$$1 + \tan a \tan b \cos C = 0.$$

7. Define a differential co-efficient; and find those of $(a + x)^3$ and $\sin(\sin x)$ from first principles.

8. Prove by a method of equating co-efficients that

$$f(x) = f(0) + xf'(0) + \frac{x^2}{1\cdot 2}f''(0) + \ldots$$

and state any objections to this process.

Expand, by this theorem, $\tan x$ in ascending powers of x as far as x^5.

9. Define a maximum or minimum value of a varying function, and examine the conditions necessary that such a value may exist.

   Prove that $x \sin x$ has an infinite number of maximum and minimum values: and show by a diagram how they lie.

10. When a relation between x and y is given in the form $\phi(x, y) = 0$ how can we obtain the value of dy/dx?

    If $x^3 + 3axy + y^3 = 0$, prove that

$$\frac{x\frac{dy}{dx} - y}{x\frac{dy}{dx} + y} = \frac{axy}{y^3 - x^3}.$$

J. E. A. S.

June 1889

MECHANICS

1. Define acceleration, paying due regard to its direction. Express an acceleration of 32 feet per second per second, in miles and hours.

2. How is the poundal defined? What velocity will a mass of 12 pounds acquire in 5 minutes if acted on by a force of 20 poundals?

3. With what velocity must a stone be thrown up from the foot of a tower which is 200 feet high so as to meet halfway a stone which is at the same instant dropped from the top? Take $g=32$ feet per second per second.

4. What are the conditions necessary for the equilibrium of a body acted on by any number of parallel forces in one plane?

   A horizontal bar 7 feet long is supported at both ends: weights of 120 and 140 pounds are applied at distances of 2 and 3 feet respectively from the ends; find the pressure on each support.

5. Define the centre of gravity of a body. What theorems give importance to a knowledge of its position?

   From a square plate A B C D, centre O, the triangle D O C is cut: find the centre of gravity of the remainder.

6. A body weighing 20 pounds is held at rest by an applied force on a smooth inclined plane of which the height is 5 and the base 12 feet: what is the force in pounds if it acts (1) along the slope, (2) parallel to the base.

7. The water-level in a jar of gas standing over a pneumatic trough is 6 inches above the level outside: what is the pressure of the gas if the barometer stands at 30 inches? If the volume of the gas in these circumstances is 20 cubic inches, what will its volume become if the water-level is made the same inside and outside? Specific gravity of mercury, 13·56.

8. What is meant by the hodograph of the motion of a point? Prove that the velocity in the hodograph is equal to the acceleration in the path both as regards magnitude and direction.

9. If a body is rotating uniformly in a circle of radius r with velocity v, show that the acceleration is towards the centre and equal to v^2/r. Hence find the tension in poundals of a string 3 feet long, at the end of which a mass of 14 pounds is being swung roung 180 times a minute.

10. A flywheel, 5 feet in diameter and weighing 4 tons, is rotating 300 times a minute; what is its kinetic energy? what couple continuously applied would be required to stop it in 15 revolutions?

11. Two perfectly inelastic bodies, masses 9 and 11 pounds, moving in opposite directions, with velocities 5 and 4 feet per second respectively, impinge directly: find the common velocity after the impact and the dissipation of energy in foot-poundals.

J. M. C.

June 1889

PHYSICS

N.B.—At least two questions must be done in each of the groups A and B, and not more than ten altogether.

A

1. Describe the general character of wave motion. Prove that when a wave travels through a long uniform tube of air the condensed portions are moving forward and the rarefied portions backward.

2. Explain the formation of nodes in a vibrating string, and deduce the character of the vibrations in an organ pipe.

   A pipe is four feet long, what are the wave lengths of its gravest three tones, (*a*) when closed, (*b*) when open? Explain why a partial closure of the top of an open pipe lowers its pitch.

3. State the laws of reflection of light, and explain the character of the reflection at a plane surface.

   Two plane mirrors inclined at one hundred and twenty degrees stand upright, forming an angle, on a figured tablecloth. Describe the appearances presented to an eye whose angular distances from the two mirrors are, (*a*) equal, (*b*) as two to one.

4. Explain the interference phenomena that are exhibited by either (*a*) Fresnel's mirrors, or (*b*) a biprism, or (*c*) Lloyd's apparatus.

   Why must the two sources of light be derived from one source? If b be the distance between them, a the interval between the bands, λ the wave-length of the light examined, and d the distance of the screen, then $\lambda d = ab$.

B

5. What do we mean by lines of magnetic force?

   Shew approximately by a diagram how they run when two equal bar magnets are placed so as to form the opposite sides of a rectangle with their like poles (*a*) in the same direction, (*b*) in opposite directions.

6. Define the capacity of a conductor and of a condenser, and explain why the capacity of the latter is increased by bringing the plates closer together.

   A condenser is formed of an insulated sphere of radius a within an uninsulated sphere of radius b: shew that its capacity is $ab / (b - a)$.

7. Define Electromotive Force: and illustrate by a diagram how it varies in a common Volta's cell (*a*) when the circuit is open, (*b*) when it is closed.

8. Describe some of the phenomena of electric induction; and state Lenz's law connecting the current induced with the motion of the circuit in which it arises.

   Describe some experiment illustrating this point.

C

9. How may the expansion of mercury by heat be best determined? Describe the apparatus used by Regnault, and explain its principle.
10. What is specific heat? What important specification must be made in defining the specific heat of a gas? State from the principle of energy what is the character of the effect of the condition of the gas on its specific heat.
11. What is the probable constitution of a gas? Show how the phenomena (*a*) of diffusion, (*b*) of spectrum analysis give weight to the hypothesis you accept.
12. Explain the action of the air thermometer. What determines the limit of the temperature of the air in the bulb when exposed to continued radiation?
13. A plate of glass and a plate of rock salt are successively placed similarly between a thermopile and a source of radiant heat. Supposing that the further face of the thermopile is kept at constant temperature, what will be (*a*) the immediate, (*b*) the ultimate character of the readings of the galvanometer?
14. Give a brief account of the theory of exchanges, and explain any two well-known phenomena that depend for their explanation upon this theory.

J. E. A. S.

June 1889

PHYSICAL LABORATORY

Written Examination

1. How is a microscope with micrometer eye piece used in measuring small lengths?
2. Enumerate the adjustments that must be made both in spectrometer and prism when measuring the refractive index of the substance of the prism for some particular monochromatic light.

3. Describe the arrangement of your apparatus *either* for measuring the resistance of a battery by Mance's method; *or* for measuring the electromotive force of a cell by Clark's potentiometer method.
4. If you had a tuning fork, and a pendulum of known period and with a glass plate attached in the plane of vibration how could you measure the pitch of the fork ?
5. In finding the coefficient of expansion of a rod of metal by a mirror method how do you (1) adjust your light, (2) find the value of the deflections ?

J. E. A. S.

June 1889

PHYSICAL LABORATORY

PRACTICAL EXAMINATION

N.B.—Four Questions may be tried, one in section A, and not more than two in any other section. The latter questions in each section will receive most credit.

A

1. Find the specific gravity of the piece of rock salt given you.
2. Find the modulus of elasticity of the substance of the given rod.
3. Find the co-efficient of rigidity of the given wire.
4. Determine "g" in the C.G.S. system by Kater's Pendulum.

B

5. Determine the pitch of the given fork by the monochord, and verify it by measuring the length of the equiperiodic column of vibrating air.
6. Adjust the two Lissajou mirrors to give an interval of one-fifth.

C

7. Find the magnifying power of the given telescope at a distance of (*a*) 12, (*b*) 20 feet down the object.
8. Find the focal length of the convex mirror, (*a*) by an optical method, (*b*) by the spherometer.
9. Find the index of refraction for the given liquid of the D line, and the strontium blue (δ) line.

D

10. Find the specific heat of the given liquid (sulphuric acid).
11. Find the latent heat of steam.
12. Find the mean apparent co-efficient of expansion of water in glass between the temperatures 20° and 40° C.

E

13. With the given apparatus (a compass needle and a bar magnet) find the moment of the given magnet in terms of the horizontal intensity af the earth's field.
14. Find the ratio of the strength of field due to a circular current at a point lying on the axis at a distance from the centre equal to the radius to that at the centre.
15. Compare the eloctromotive forces of the two given cells by Poggendorff's or other null method ; and verify your result by another method.
16. Determine the resistance of the given cell by Mance's method, and by a condenser or other good test. Compare and criticise the two results.

J. E. A. S.

J. M. C.

JUNIOR CHEMISTRY.

June 1889.

1. What are the halogens? Indicate the relationship which exists between their atomic weights and their chemical and physical properties.
2. What volume of gas at 200°C and 740 M.M. pressure is produced in the complete combustion of 500 grms. of sulphuretted hydrogen?
3. Describe fully the part played by the nitrogen compounds employed in the manufacture of H_2SO_4.
4. CO, SO_2, and SH_2 are all said to be reducing agents; give instances with equations of their behaviour in this capacity.
5. Describe experiments proving that CO_2 and SH_2 contain their own volumes of oxygen and hydrogen respectively.
6. Give an account of the preparation of either silicon chloride or silicon fluoride, and indicate by equations the action of water on either of these substances.
7. What are the principal constituents of crude coal-gas, and how are the objectionable ones removed in practice?
8. Define the terms
   (*a*) Atomic Weight,
   (*b*) Molecular Weight,
   (*c*) Vapour Density,
   (*d*) Dissociation.

P. F. F.

SENIOR CHEMISTRY (INORGANIC).

1. Describe briefly the more important methods of obtaining metallic zinc from its ores.
2. In the case of which metals, by what means and with what results has the molecular weight in the gaseous state been ascertained?
3. Give some account of the metals the existence of which had been predicted by Mendelejeff.
4. What is a *clay?* Write a short description of the manufacture of porcelain.

5. Name the compounds which lead forms with oxygen, state how they may be prepared, and briefly describe their properties.
6. Given metallic mercury, how would you prepare mercuric chloride, mercurous chloride, mercuric sulphide (black and red), Nessler's solution?
7. Contrast the two classes of compounds formed by the metal tin.
8. What is meant by the terms *isomorphism* and *dimorphism?* Illustrate your answer by special reference to the alums and carbonate of lime.

P. F. F.

SENIOR CHEMISTRY (ORGANIC).

June 1889.

1. Given marsh-gas, indicate how the following compounds can be prepared:—acetic acid, acetone, ethyl alcohol, and ethylamine.
2. What are the carbohydrates? Classify the more common members of this group, and point out the principles on which this classification is based.
3. Give the names and formulæ (constitutional if possible) of at least one of each of the following types of compounds:—(*a*) secondary alcohol, (*b*) hydroxy-acid, (*c*) dibasic acid, (*d*) hexahydric alcohol, (*e*) isothiocyanate.
4. How is the isomerism amongst the cyanides generally explained? Adduce evidence in support of this explanation.
5. Give an account of the occurrence of urea, and indicate how it can be artificially prepared.
6. Give instances of the conversion of fatty into aromatic compounds.
7. Write the constitutional formulæ of the following compounds:—(*a*) metaxylene, (*b*) para-di-nitro-benzene, (*c*) terephthalic acid, (*d*) symmetrical tribrom-benzene, (*e*) para-rosaniline.
8. Contrast the action of nitrous acid on ethylamine and aniline respectively.

P. F. F.

CHEMICAL LABORATORY AND ANALYTICAL CLASS.

WRITTEN EXAMINATION.

June 1889.

QUALITATIVE.

1. What takes place when boiling H_2SO_4 acts on metallic copper? Name and describe the properties of the gas produced.
2. How would you prepare chlorine gas? Enumerate the properties which distinguish it from any other gas you have prepared in the Laboratory.
3. A powder contains Pb_3O_4 and $Cr_2(SO_4)_3$. What dry tests would you employ to prove the presence of Pb, Cr, and S?
4. Point out the differences between (*a*) mercurous and mercuric salts, (*b*) ferrous and ferric salts, (*c*) zinc and aluminium salts.
5. Why is it necessary in the copper group to add (1) HCl before passing H_2S, and (2) H_2S in the wash water? and (3) why is it necessary to add ammonium and ammonium-chloride in the iron group?
6. Indicate the methods you would employ for the separation of the metals of the calcium group.
7. Give the chief tests for (*a*) H_3BO_3, (*b*) H_3PO_4, and (*c*) $HClO_3$.
8. A solution containing a mixture of the Sodium Salts of HCl, HBr, HI, and HNO_3 is given you for analysis. How would you prove the presence of each of these acids?
9. One solution contains Na_3AsO_4 and Na_2HPO_4, and the other contains KNO_2 and KNO_3. What tests would you employ to prove the presence of the acids in each mixture?
10. An alloy containing Hg, Bi, Pb, and Sb is given you for analysis. How would you prove the presence of each of the constituent metals?

QUANTITATIVE.

1. Describe accurately how you would determine the quantity of phosphoric acid (calculated as P_2O_5) in a given volume of a solution of ammonium phosphate.

2. In a solution containing iron and manganese, how would you separate these metals, and determine their amounts respectively.
3. What impurities would you expect to find in commercial sulphuric acid? How would you detect their presence, and how would they be severally removed?
4. Devise a scheme for the complete quantitative analysis of a sample of magnesian limestone.
5. Give a complete account of the method you would employ in determining the percentage of chlorine in a sample of rock salt.
6. What is meant by a "*normal solution of sulphuric acid*," and how would you utilise such a solution in determining the percentage of ammonia in ammonium sulphate?

P. F. F.
A. T.

JUNIOR ENGINEERING.

March 1889.

1. What is a couple? In what circumstances are two couples equivalent to one another?

2. State the principle of the polygon of forces and draw the polygon for the top joint of a crane, showing how to find the stress in the jib and tie (1) when the chain that carries the load is led back over a pulley at the top, and (2) when the chain is jammed at the pulley and is slack behind.

3. Give the position, amount, and direction of the resultant pressure of water on a vertical retaining wall 14 feet deep and 40 feet long, the water level being 2 feet from the top of the wall.

4. Show how you might apply the method of moments to find the centre of pressure on the foundations of the wall in Question 3.

5. Define the metacentre of a floating body, and give an example. What does the position of the metacentre show as to stability?

6. A block weighing 1 cwt. is moved along a level surface by a horizontal force equal to the weight of 10 lbs. What will the velocity be after three seconds, starting from rest, if the co-efficient of friction is $\frac{1}{10}$?

7. What work is done in setting in motion a cast-iron disc 2 feet in diameter and 3 inches thick, with a speed of 300 turns per minute?

8. Define the terms "pitch-point," "line of connection," and "path of contact" in relation to toothed wheels, and show why the line of connection must pass through the pitch point.

9. Define the instantaneous axis of a moving piece, and state some of its uses, giving an example.

10. In a rope dynamometer the pull of the rope on one side is 20 lbs. and on the other it is 120 lbs. The diameter of the drum is three feet, and it makes 90 turns per minute. Find the horse power that is being absorbed.

J. A. E.

JUNIOR ENGINEERING.

Workshop Appliances.

1. Describe in general terms the distinction between "end" and "line" measurements of length, giving instances, and say how each of these methods is applied in comparing lengths with great accuracy.
2. What is the process of setting saw teeth, and what is its object?
3. Say what you know about the naming and classing of files.
4. Give a short account of the process employed by Whitworth in the original formation of a truly plane surface.
5. Sketch in vertical section along the mandril a form of headstock for a small lathe.
6. Describe one form of self-centreing chuck.
7. What are the functions of (1) the leading screw, (2) the rack, and (3) the back shaft in giving motion to the tool-holder in a fully-equipped self-acting lathe?
8. Describe a form of quick-return gear suitable for a planing machine.
9. How are steam-engine cyclinders bored?
10. Describe at least two forms of lubricator for delivering oil slowly to the bearings of a shaft.

J. A. E.

SURVEYING, &c.

June 1889.

1. State and prove the geometrical principle of the sextant.
2. Define the line of collimation of a telescope, and say how you test whether the line of collimation is horizontal when the bubble is at the centre of its run in a Y level.
3. Describe one method by which temperature errors are avoided in measuring the base line of a large triangular survey.
4. Explain what is meant by the correction for curvature and refraction in levelling, and say under what circumstance it is and is not necessary to apply the correction.

5. Give one method of finding the true north.
6. Fill up and check a level-book from the following data :—Sights are taken on points of which the distances are 100, 200, 300, and 400 links, and the reduced levels are respectively 52·35, 54·72, 60·38, 63·53; the level is then shifted, so that the line of collimation is raised 6 ft. and a back sight is taken on the staff at 400 and another sight on a staff at 430, where the reduced level is 65·23 and the staff reading is 5·77.
7. Two straight portions of a railway have their entire lines intersecting at 140° to each other, and are to be joined by a curve of 10 chains radius. Find the distance of the springing from the point of intersection of the tangent, the length of the curve, and the angle at the circumference for an arc of 1 chain. Tan 70° = 2·7475.
8. In a hydrographic survey describe how to find the successive position of the boat while taking a line of soundings across a harbour, and say how you reduce the soundings to low water datum.

J. A. E.

DRAWING.

I.

June 1889.

1. Draw two combined half-elevations and sections of a steel connecting-rod end, using the proportional numbers given in the sketch, the diameter, *d*, of the bolts being the unit. The bolts to stand a load of 16,400 lbs., allowing a working stress 6,500 lbs. per sq. inch. Diameter of crank pin, 4″; length, $4\frac{1}{2}$″; diameter of rod, $2\frac{3}{8}$″. Scale, full size.

J. A. E.
T. R.

DRAWING.

II.

(*Three questions only to be answered.*)

1. Draw the tangent to a circular arc, at any point, the centre being unavailable.

2. Draw the projections of a hexagonal nut, $1\frac{1}{2}''$ across flats, and $\frac{7}{8}''$ thick, when the line joining its opposite corners is inclined 30° to the horizontal plane.
3. A right cylinder, 2″ diameter, with its axis vertical, is cut by a plane inclined at 30°. Draw the development of the curve of section.
4. A vertical cylinder, 2″ diameter, is penetrated at right angles by a cylinder 2″ diameter, the axis of which is displaced $\frac{1}{2}''$ from the axis of the first. Determine the projections of the curve of intersection.
5. Given three lines inclined to each other; but not intersecting: describe a circle to touch the lines.
6. Given a semi-circle, complete the circle without making use of its centre.

J. A. E.
T. R.

ZOOLOGY.

Answer five questions. Time, two hours.

1. Give the structure of a typical medusa.
2. Illustrate by examples the chief features of parasitic life.
3. Compare as regards external form the following Mollusca :— chiton, anodon, limpet, a pteropod, and a cuttle-fish.
4. Trace the life-history of any animal with a larval development, and indicate the lessons of such a history.
5. Compare by diagrams the circulation in a fish, tadpole, frog, bird, and mammal.
6. Discuss the special points of interest in the lampreys and in the dipnoi.
7. Give an account of the structure, geographical distribution, and affinities of the monotremata. (8) Or of the ratite birds.

ZOOLOGY—SUMMER SESSION.

Answer five questions. Time, two hours.

1. Compare the structure of hydra, actinia, and a medusa.
2. Describe the structure of a star-fish.
3. Describe the life-history of a tape-worm.
4. What organs in an ascidian suggest vertebrate affinities.
5. Describe the shoulder-girdle, wing, pelvic-girdle, and leg of a bird.
6. Compare the brains of a frog, lizard, bird, and mammal.
7. Give an account of the chief characters of the Edentata ; naming the chief genera, and giving their distribution.

D. W. T.

BOTANY.

June 1889.—2—4.

Four Questions only to be answered. Diagrams to be given as much as possible.

1. We have observed living plants grown

   (*a*) In darkness.
   (*b*) In red light.
   (*c*) In blue light.
   (*d*) In full sunshine.
   (*e*) In daylight, without iron.
   (*f*) ,, ,, oxygen.
   (*g*) ,, ,, carbonic anhydride.

   What do you remember as the result in each case?

2. Explain carefully what you understand by (*a*) artificial selection. (*b*) natural selection.

3. (*a*) Describe with diagrams the life-history of marchantia, (*b*) comparing it with the life-history of a male fern and of a pollen-grain.

4. Explain with diagrams the structure of an elm stem
   (*a*) of one year.
   (*b*) of two years.

5. Describe the flower supplied, and explain (with diagrams) how it is adapted to cross fertilisation.

P. G.

ANATOMY.

First Examination.

(*Three questions to be attempted.*)

1. Describe the foetal membranes.
2. Describe the parietal bone.
3. Give the articulations of the semilunar.
4. Describe the sternum.

Second Examination.

1. Describe the structure of bone.
2. Describe the sterno-clavicular articulation: what muscles act upon it?

Third Examination.

1. Describe the biceps of the arm or leg.
2. Describe the brachial or popliteal artery.
3. Describe the stomach.
4. Describe the development of the urinary organs.

A. M. P.

SATURDAY GREEK (TEACHERS') CLASS.

LUCIAN : SELECTIONS.

I. Translate :—

Κατέλαβον ἐν τῷ ἄντρῳ ἀπὸ τῆς νομῆς ἀναστρέψας πολλούς τινας, ἐπιβουλεύοντας δῆλον ὅτι τοῖς ποιμνίοις· ἐπεὶ γὰρ ἐπέθηκα τῇ θύρᾳ τὸ πῶμα—πέτρα δέ ἐστι παμμεγέθης—καὶ τὸ πῦρ ἀνέκαυσα ἐναυσάμενος ὃ ἔφερον δένδρον ἀπὸ τοῦ ὄρους, ἐφάνησαν ἀποκρύπτειν αὑτοὺς πειρώμενοι· ἐγὼ δὲ συλλαβών τινας αὐτῶν, ὥσπερ εἰκὸς ἦν, κατέφαγον λῃστάς γε ὄντας. ἐνταῦθα ὁ πανουργότατος ἐκεῖνος, εἴτε Οὖτις εἴτε Ὀδυσσεὺς ἦν, δίδωσί μοι πιεῖν φάρμακόν τι ἐγχέας, ἡδὺ μὲν καὶ εὔοσμον, ἐπιβουλότατον δὲ καὶ ταραχωδέστατον· ἅπαντα γὰρ εὐθὺς ἐδόκει μοι περιφέρεσθαι [πιόντι] καὶ τὸ σπήλαιον αὐτὸ ἀνεστρέφετο καὶ οὐκέτι ὅλως ἐν ἐμαυτοῦ ἦμην, τέλος δὲ ἐς ὕπνον κατεσπάσθην. ὁ δὲ ἀποξύνας τὸν μοχλὸν καὶ πυρώσας γε προσέτι ἐτύφλωσέ με καθεύδοντα, καὶ ἀπ' ἐκείνου τυφλός εἰμί σοί, ὦ Πόσειδον.

Parse and give principal parts of ἀναστρέψας, ἐπέθηκα, ἔφερον, κατέφαγον, ἐγχέας.

II. Translate, with short notes explaining allusions or syntax :—

ἐγκοπέα γάρ τινά μοι δοὺς ὁ θεῖος ἐκέλευσέ μοι ἠρέμα καθικέσθαι πλακὸς ἐν μέσῳ κειμένης, ἐπειπὼν τὸ κοινὸν "ἀρχὴ δέ τοι ἥμισυ παντός." σκληρότερον δὲ κατενεγκόντος ὑπ' ἀπειρίας κατεάγη μὲν ἡ πλάξ, ὁ δὲ ἀγανακτήσας σκυτάλην τινὰ πλησίον κειμένην λαβὼν οὐ πρᾴως οὐδὲ προτρεπτικῶς μου κατήρξατο, ὥστε δάκρυά μοι τὰ προοίμια τῆς τέχνης.

(Explain κατήρξατο.)

ἐπεὶ δ' οὖν ἐνίκησέ τε καὶ τὸν ὅλεθρον ἐκεῖνον Δαρεῖον ἐν Ἰσσῷ τε καὶ Ἀρβήλοις ἐκράτησεν, ἀποστὰς τῶν πατρῴων προσκυνεῖσθαι ἠξίου καὶ ἐς δίαιταν τὴν Μηδικὴν μετεδιήτησεν ἑαυτὸν καὶ ἐμαιφόνει ἐν τοῖς συμποσίοις τοὺς φίλους καὶ συνελάμβανεν ἐπὶ θανάτῳ.

(Explain historical allusions.)

MEN. Τούτου γε ἕνεκα καὶ νεωλκήσας τὸ πορθμεῖον παράμενε· πλὴν ἀλλ' ὅ γε μὴ ἔχω, πῶς ἂν λάβοις ;

ΧΑΡ. Σὺ δ' οὐκ ᾔδεις ὡς κομίζεσθαι δέον ;

MEN. Ἥιδειν μέν, οὐκ εἶχον δέ. τί οὖν ; ἐχρῆν διὰ τοῦτο μὴ ἀποθανεῖν ;

ΧΑΡ. Μόνος οὖν αὐχήσεις προῖκα πεπλευκέναι ;

MEN. Οὐ προῖκα, ὦ βέλτιστε· καὶ γὰρ ἠντλησα καὶ τῆς κώπης συνεπελαβόμην καὶ οὐκ ἔκλαον μόνος τῶν ἄλλων ἐπιβατῶν.

(ᾔδεις—προικα—μόνος τῶν ἄλλων.)

III. Give the meaning of ἐπιδικάτιμος, αὐτῇ, σκευῇ, πορθμείου, σοφιστῇ, κύφωνες.

IV. Give the constructions of ὥστε and ὅπως.

V. Who were Lucian, Menippus, Minos, the Cyclops, Arion?

VI. Translate into Greek :—

(1.) And the ape follows willingly for a time ; but, suddenly getting scent as though from the water, then he no longer is willing to go with those who are leading him, but wishes to pursue the smell.

(2.) But fearing the letter, as knowing how many apples there were, he hid it under a great stone, and having retired far from thence, he again took out two apples and ate them up.

JUNIOR GREEK.

Monday, June 17.—10—1.

XENOPHON ANABASIS IV. : GRAMMAR : COMPOSITION.

I. Translate :—

Ἔνθα δὴ οἱ μὲν Καρδοῦχοι ἐκλιπόντες τὰς οἰκίας, ἔχοντες καὶ γυναῖκας καὶ παῖδας, ἔφευγον ἐπὶ τὰ ὄρη· τὰ δὲ ἐπιτήδεια πολλὰ ἦν λαμβάνειν· ἦσαν δὲ καὶ χαλκώμασι παμπόλλοις κατεσκευασμέναι αἱ οἰκίαι, ὧν οὐδὲν ἔφερον οἱ Ἕλληνες· οὐδὲ τοὺς ἀνθρώπους ἐδίωκον, ὑποφειδόμενοι, εἴ πως ἐθελήσειαν οἱ Καρδοῦχοι διέναι αὐτοὺς ὡς διὰ φιλίας τῆς χώρας, ἐπείπερ βασιλεῖ πολέμιοι ἦσαν. Τὰ μέντοι ἐπιτήδεια, ὅτῳ τις ἐπιτυγχάνοι, ἐλάμβανον· ἀνάγκη γὰρ ἦν. Οἱ δὲ Καρδοῦχοι

οὔτε καλούντων ὑπήκουον οὔτε ἄλλο τι φιλικὸν οὐδὲν ἐποίουν. Ἐπεὶ δὲ οἱ τελευταῖοι τῶν Ἑλλήνων κατέβαινον εἰς τὰς κώμας ἀπὸ τοῦ ἄκρου ἤδη σκοταῖοι, (διὰ γὰρ τὸ στενὴν εἶναι τὴν ὁδὸν ὅλην τὴν ἡμέραν ἡ ἀνάβασις αὐτοῖς ἐγένετο καὶ κατάβασις) τότε δὴ συλλεγέντες τινὲς τῶν Καρδούχων τοῖς τελευταίοις ἐπέθεντο καὶ ἀπέκτειναν τινας καὶ λίθοις καὶ τοξεύμασι κατέτρωσαν, ὀλίγοι τινές ὄντες· ἐξ ἀπροσδοκήτου γὰρ αὐτοῖς ἐπέπεσε τὸ Ἑλληνικόν. Εἰ μέντοι τότε πλείους συνελέγησαν, ἐκινδύνευσεν ἂν διαφθαρῆναι πολὺ τοῦ στρατεύματος. Καὶ ταύτην μὲν τὴν νύκτα οὕτως ἐν ταῖς κώμαις ηὐλίσθησαν· οἱ δὲ Καρδοῦχοι πυρὰ πολλὰ ἕκαιον κύκλῳ ἐπὶ τῶν ὀρέων, καὶ συνεώρων ἀλλήλους.

Parse the words underlined.

II. Give the genitive singular and dative plural of *νεώς, ἔρις, ἔρως, κέρας, ὀδούς, μήτηρ, γένος, πόλις, ἄστυ, γόνυ, δόρυ, γέρας, ναῦς, πούς, ὕδωρ, υἱός.*

III. Compare *κοῦφος, σαφής, ἡδύς, μέγας, ἀγαθός, μικρός, πολύς, ῥάδιος, ἐχθρός, ἀλγεινός, πρό.*

IV. Decline in full *ἐγώ, οὗτος, ἑαυτόν, ὅστις.*

V. Conjugate the present and imperfect indicative and the present optative and present imperative active of *εἰμί* (to be), *λύω, δηλῶ, τιθημι,* and the present subjunctive and present imperative middle of *ποιῶ, τιμῶ, ἵστημι,* and *δίδωμι.*

VI. Translate into Greek :—

(1.) The sailors who reported what was done did not tell the truth.

(2.) Do not wear out your clothes, O daughter.

(3.) Let us sacrifice twelve oxen to Zeus.

(4.) Let the happy slave dance all night.

(5.) No one ever remained in the city through the whole summer.

(6.) The horns of this ox were the gift of the poor citizens.

SENIOR GREEK CLASS.

First Paper.

Thursday, 20th June.—2—5.

Composition : Iliad, Book I.

I. Translate into Greek :—

(α) On the next day, Jason commanded all his companions to go on board the ship ; for he perceived that he would be in great danger if he remained in that place. This having been done, he set sail without delay, and exhorted the sailors to row with all their might. Meanwhile Aeetes was informed that Medea had escaped from the city, and being greatly displeased he launched a ship of war and set sail at once, to pursue the fugitives.

(β) The enemy, after slaying the guards, became masters of the acropolis.

I advise those who have more money than I have to purchase such things.

He said that if they had done this, they would have become more powerful than ever.

This person is worthy of praise, because he has rendered hi country many benefits.

Do not send me away when I make a just request for you.

II. Translate :—

(1) Οἰνοβαρές, κυνὸς ὄμματ' ἔχων, κραδίην δ' ἐλάφοιο·
οὔτε ποτ' ἐς πόλεμον ἅμα λαῷ θωρηχθῆναι,
οὔτε λόχονδ' ἰέναι σὺν ἀριστήεσσιν Ἀχαιῶν
τέτληκας θυμῷ· τὸ δέ τοι κὴρ εἴδεται εἶναι.
ἦ πολὺ λώϊόν ἐστι, κατὰ στρατὸν εὐρὺν Ἀχαιῶν
δῶρ ἀποαιρεῖσθαι, ὅστις σέθεν ἀντίον εἴπῃ.
δημοβόρος βασιλεύς, ἐπεὶ οὐτιδανοῖσιν ἀνάσσεις·
ἦ γὰρ ἄν, Ἀτρεΐδη, νῦν ὕστατα λωβήσαιο.

Parse ἀριστήεσσιν, τέτληκας, σέθεν, ὕστατα.

(2) Ζεῦ πάτερ, εἴ ποτε δή σε μετ' ἀθανάτοισιν ὄνησα
ἢ ἔπει, ἢ ἔργῳ, τόδε μοι κρήηνον ἐέλδωρ·
τίμησόν μοι υἱόν, ὃς ὠκυμορώτατος ἄλλων
ἔπλετ'· ἀτάρ μιν νῦν γε ἄναξ ἀνδρῶν Ἀγαμέμνων
ἠτίμησεν· ἑλὼν γὰρ ἔχει γέρας, αὐτὸς ἀπούρας.
ἀλλὰ σὺ πέρ μιν τῖσον, Ὀλύμπιε μητίετα Ζεῦ·
τόφρα δ' ἐπὶ Τρώεσσι τίθει κράτος, ὄφρ' ἂν Ἀχαιοὶ
υἱὸν ἐμὸν τίσωσιν, ὀφέλλωσίν τ' ἐπὶ τιμῇ.
Ὣς φάτο· τὴν δ' οὔ τι προσέφη νεφεληγερέτα Ζεύς,
ἀλλ' ἀκέων δὴν ἧστο· Θέτις δ', ὡς ἥψατο γούνων,
ὣς ἔχετ' ἐμπεφυυῖα, καὶ εἴρετο δεύτερον αὖτις·
Νημερτὲς μὲν δή μοι ὑπόσχεο καὶ κατάνευσον,
ἢ ἀπόειπ'· ἐπεὶ οὔ τοι ἔπι δέος· ὄφρ' εὖ εἰδῶ,
ὅσσον ἐγὼ μετὰ πᾶσιν ἀτιμοτάτη θεός εἰμι.
Τὴν δὲ μεγ' ὀχθήσας προσέφη νεφεληγερέτα Ζεύς·
ἦ δὴ λοίγια ἔργ', ὅτε μ' ἐχθοδοπῆσαι ἐφήσεις
Ἥρῃ, ὅτ' ἄν μ' ἐρέθῃσιν ὀνειδείοις ἐπέεσσιν·
ἡ δὲ καὶ αὔτως μ' αἰεὶ ἐν ἀθανάτοισι θεοῖσιν
νεικεῖ, καί τέ μέ φησι μάχῃ Τρώεσσιν ἀρήγειν.
ἀλλὰ σὺ μὲν νῦν αὖτις ἀπόστιχε, μή τι νοήσῃ
Ἥρη· ἐμοὶ δέ κε ταῦτα μελήσεται, ὄφρα τελέσσω.

Parse ὄνησα, κρήηνον, ἀπούρας, ἥψατο, ὑπόσχεο, ἔπι, ἐφήσεις, μελήσεται.

III. Explain the following: ὑπόδρα ἰδών, αἰθ' ὄφελες.....ἧσθαι, πόσιος καὶ ἐδητύος ἐξ ἔρον ἔντο, ἐπαρξάμενοι δεπάεσσιν, ἵκμενος οὖρος, ἐπὶ ἦρα φέρων, ἀμφιγυηείς, ἐκ δ' εὐνὰς ἔβαλον, οὐλοχύτας προβάλοντο.

SENIOR GREEK.

SECOND PAPER.

Friday, 21st June 1889.—10—1.

TRANSLATION AT SIGHT: AESCHYLUS, AGAMEMNON.

I. Translate:—

ΛΥ. Ὦ Σώκρατες, οὗτος μέντοι ὁ ἔπαινός ἐστι καλός, ὃν σὺ νῦν ἐπαινεῖ ὑπ' ἀνδρῶν ἀξίων πιστεύεσθαι. εὖ οὖν ἴσθι ὅτι ἐγὼ ταῦτα ἀκούων χαίρω ὅτι εὐδοκιμεῖς. καὶ σὺ δὲ ἡγοῦ με ἐν τοῖς γ' εὐνουστάτοις σοι εἶναι.

χρῆν μὲν οὖν καὶ πρότερόν γε φοιτᾶν αὐτὸν παρ' ἡμᾶς καὶ οἰκείους ἡγεῖσθαι, ὥσπερ τὸ δίκαιον· νῦν δ' οὖν ἀπὸ τῆσδε τῆς ἡμέρας, ἐπειδὴ ἀνεγνωρίσαμεν ἀλλήλους, μὴ ἄλλως ποιει, ἀλλὰ σύνισθί τε καὶ γνώριζε καὶ ἡμᾶς καὶ τούσδε τοὺς νεωτέρους. ταῦτα μὲν οὖν καὶ σὺ ποιήσεις καὶ ἡμεῖς σε καὶ αὖθις ὑπομνήσομεν· περὶ δὲ ὧν ἠρξάμεθα τί δοκεῖ;

ΣΩ. Ἀλλὰ καὶ τούτων πέρι, ὦ Λυσίμαχε, ἔγωγε πειράσομαι συμβουλεύειν ἄν τι δύνωμαι, καὶ αὖ ἃ προκαλεῖ πάντα ποιεῖν. δικαιότατον μέντοι μοι δοκεῖ εἶναι, ἐμὲ νεώτερον ὄντα τῶνδε ἀκούειν πρότερον τί λέγουσι καὶ μανθάνειν παρ' αὐτῶν· ἐὰν δ' ἔχω τι ἄλλο παρὰ τὰ ὑπὸ τούτων λεγόμενα, τότ' ἤδη διδάσκειν καὶ πείθειν καὶ σὲ καὶ τούτους.

II.

(α) χειμῶνα δ' εἰ λέγοι τις οἰωνοκτόνον,
οἷον παρεῖχ' ἄφερτον Ἰδαία χιών,
ἢ θάλπος, εὖτε πόντος ἐν μεσημβριναῖς
κοίταις ἀκύμων νηνέμοις εὕδοι πεσών·
τί ταῦτα πενθεῖν δεῖ; παροίχεται πόνος·
παροίχεται δὲ, τοῖσι μὲν τεθνηκόσιν
τὸ μήποτ' αὖθις μηδ' ἀναστῆναι μέλειν.
τί τοὺς ἁναλωθέντας ἐν ψήφῳ λέγειν,
τὸν ζῶντα δ' ἀλγεῖν χρὴ τύχης παλιγκότου;
καὶ πολλὰ χαίρειν ξυμφοραῖς καταξιῶ.
ἡμῖν δὲ τοῖς λοιποῖσιν Ἀργείων στρατοῦ
νικᾷ τὸ κέρδος, πῆμα δ' οὐκ ἀντιρρέπει.
ὡς κομπάσαι τῷδ' εἰκὸς ἡλίου φάει,
ὑπὲρ θαλάσσης καὶ χθονὸς ποτωμένοις·
Τροίαν ἑλόντες δήποτ' Ἀργείων στόλος
θεοῖς λάφυρα ταῦτα τοῖς καθ' Ἑλλάδα
δόμοις ἐπασσάλευσαν ἀρχαῖον γάνος.

(β) ξυνώμοσαν γὰρ, ὄντες ἔχθιστοι τὸ πρὶν,
πῦρ καὶ θάλασσα, καὶ τὰ πίστ' ἐδείξάτην,
φθείροντε τὸν δύστηνον Ἀργείων στρατόν.
ἐν νυκτὶ δυσκύμαντα δ' ὡρώρει κακά.
ναῦς γὰρ πρὸς ἀλλήλαισι Θρῄκιαι πνοαὶ
ἤρεικον· αἱ δὲ κεροτυπούμεναι βίᾳ
χειμῶνι τυφῶ σὺν ζάλῃ τ' ὀμβροκτύπῳ

ψ"χοντ' ἄφαντοι, ποιμένος κακοῦ στρόβῳ.
ἐπεὶ δ' ἀνῆλθε λαμπρὸν ἡλίου φάος,
ὁρῶμεν ἀνθοῦν πέλαγος Αἰγαῖον νεκροῖς
ἀνδρῶν 'Αχαιῶν ναυτικοῖς τ' ἐρειπίοις.
ἡμᾶς γε μὲν δὴ ναῦν τ' ἀκήρατον σκάφος
ἤτοι τις ἐξέκλεψεν ἢ 'ξῆγτήσατο
θεός τις, οὐκ ἄνθρωπος, οἷακος θιγών.

III. **Translate** and comment on :—

(1) τὰ δεσποτῶν γὰρ εὖ πεσόντα θήσομαι
τρὶς ἓξ βαλούσης τῆσδέ μοι φρυκτωρίας.

(2) ὁ δ' οὔτι μέλλων οὐδ' ἀφρασμόνως ὕπνῳ
νικώμενος παρῆκεν ἀγγέλου μέρος.

(3) εἰ δ' εὖ σέβουσι τοὺς πολισσούχους θεοὺς
τοὺς τῆς ἁλούσης γῆς θεῶν θ' ἱδρύματα,
οὗ τἂν ἑλόντες αὖθις ἀνθαλοῖεν ἄν.
ἔρως δὲ μή τις πρότερον ἐμπίπτῃ στρατῷ
πορθεῖν ἃ μὴ χρή, κέρδεσιν νικωμένους.

(4) εὐθὺς γενέσθω πορφυρόστρωτος πόρος
ἐς δῶμ' ἄελπτον ὡς ἂν ἡγῆται δίκη.

(5) σὺ ταῦτα φωνεῖς νερτέρᾳ προσήμενος
κώπῃ, κρατούντων τῶν ἐπὶ ζυγῷ δορός ;

IV. **Write a short note** on the religious and moral ideas of Aeschylus, as indicated in the Agamemnon.

W. P.

JUNIOR LATIN.

HORACE, ODES II. : VIRGIL, I. and II., 1—161 : COMPOSITION.

Monday, 17th June.—2—5.

I.

1. **Translate** :—

Bacchum in remotis carmina rupibus
vidi docentem—credite posteri—
nymphasque discentes et aures
capripedum Satyrorum acutas.

euoe, recenti mens trepidat metu
plenoque Bacchi pectore *turbidum*
laetatur. euoe, parce Liber,
parce, gravi metuende thyrso !

fas pervicaces est mihi Thyiadas
vinique fontem, lactis et uberes
cantare rivos atque truncis
lapsa cavis iterare mella ;

fas et *beatae coniugis additum*
stellis honorem tectaque *Penthei*
disiecta non leni ruina,
Thracis et exitium Lycurgi.

tu *flectis amnes*, tu mare barbarum,
tu separatis uvidus in iugis
nodo coërces viperino
Bistonidum sine fraude crines :

tu, cum parentis regna per arduum
cohors Gigantum scanderet impia,
Rhoetum retorsisti leonis
unguibus horribilique mala ;

quamquam choreis aptior et iocis
ludoque dictus non sat idoneus
pugnae ferebaris : sed idem
pacis eras mediusque belli.

te vidit insons Cerberus aureo
cornu decorum, leniter atterens
caudam, et recedentis *trilingui*
ore pedes tetigitque crura.

Scan the first stanza.

Comment on the words in italics.

2. Translate :—

(α.) Est in secessu longo locus : insula portum
efficit obiectu laterum, quibus omnis ab alto
frangitur inque sinus scindit sese unda reductos.
Hinc atque hinc vastae rupes geminique minantur
in caelum scopuli, quorum sub vertice late

aequora tuta silent: tum silvis scaena coruscis
desuper horrentique atrum nemus imminet umbra;
fronte sub adversa scopulis pendentibus antrum,
intus aquae dulces vivoque sedilia saxo,
nympharum domus: hic fessas non vincula navis
ulla tenent, unco non alligat ancora morsu.

(*b.*) 'cuncta equidem tibi, rex, fuerit quodcumque, fatebor
vera,' inquit: 'neque me Argolica de gente negabo:
hoc primum; nec, si miserum fortuna Sinonem
finxit, vanum etiam mendacemque improba finget.
fando aliquod si forte tuas pervenit ad aures
Belidae nomen Palamedis et incluta fama
gloria, quem falsa sub proditione Pelasgi
insontem infando indicio, quia bella vetabat,
demisere neci, nunc cassum lumine lugent;
illi me comitem et consanguinitate propinquum
pauper in arma pater primis huc misit ab annis.
dum stabat regno incolumis, regumque vigebat
consiliis, et nos aliquod nomenque decusque
gessimus. invidia postquam pellacis Ulixi—
haud ignota loquor—superis concessit ab oris,
adflictus vitam in tenebris luctuque trahebam,
et casum insontis mecum indignabar amici.
nec tacui demens; et me, fors si qua tulisset,
si patrios unquam remeassem victor ad Argos,
promisi ultorem, et verbis odia aspera movi.'

3. Translate and comment on—

(*a.*) Aerea cui gradibus surgebant limina, nexaeque
Aere trabes, foribus cardo stridebat aenis.

(*b.*) Et silvis aptare trabes, et stringere remos.

(*c.*) Seque ortum antiqua Teucrorum ab stirpe volebat.

(*d.*) Quaerere conscius arma.

(*e.*) Fas mihi Graiorum sacrata resolvere iura.

II. Translate into Latin:—

(1.) Why is the daughter of Balbus envied?

(2.) The consul says that he set out from Rome to take Carthage

(3.) We have forgotten the letters which the old man taught u
for so many months.

(4.) The lord will take care that the slave, whom he condemned to death, is killed.

(5.) We must spare our enemies that we may be spared ourselves.

(6.) He must go to Athens to be taught philosophy.

(7.) What prevented you keeping your word, and helping me, as you promised you would?

(8.) He said that he could not help shouting, and that he feared that he had been heard.

SENIOR LATIN CLASS.

First Paper.

Thursday, 20th June, 1889.—10—1.

Composition: Virgil, Eclogues: Translation at Sight.

I. Translate into Latin:—

Leonidas was one of the first that fell, and around his body the battle raged fiercer than ever. The Persians made the greatest efforts to gain possession of it; but four times they were driven back by the Greeks with great slaughter. At length, thinned in numbers, and exhausted by fatigue and wounds, this noble band retired within the pass, and seated themselves on a hillock behind the wall. Meanwhile the detachment which had been sent across the mountains began to enter the pass. The Thebans seized the opportunity of begging quarter, proclaiming that they had been forced to fight against their will. Their lives were spared, but the surviving Lacedæmonians were surrounded on every side, and killed to a man.

II. Translate:—

Extinctum Nymphae crudeli funere Daphnim
flebant (vos coryli testes et flumina Nymphis)
cum complexa sui corpus miserabile nati
atque deos atque astra vocat crudelia mater.
Non ulli pastos illis egere diebus
frigida, Daphni, boves ad flumina; nulla neque amnem
libavit quadrupes, nec graminis attigit herbam.
Daphni, tuum Poenos etiam ingemuisse leones
interitum montesque feri silvaeque loquuntur.

Daphnis et Armenias curru subiungere tigres
instituit, Daphnis thiasos inducere Bacchi
et foliis lentas intexere mollibus hastas.
Vitis ut arboribus decori est, ut vitibus uvae,
ut gregibus tauri, segetes ut pinguibus arvis,
tu decus omne tuis. Postquam te fata tulerunt,
ipsa Pales agros atque ipse reliquit Apollo.

III. Translate and comment on :—

(α) At mecum raucis, tua dum vestigia lustro,
sole sub ardenti resonant arbusta cicadis.

(β) Cum faciam vitula pro frugibus ipse venito.

(γ) Certe equidem audieram, qua se subducere colles
incipiunt mollique iugum demittere clivo,
usque ad aquam et veteres iam fracta cacumina fagos
omnia carminibus vestrum servasse Menalcan.

(δ) Saepibus in nostris parvam te roscida mala
(dux ego vester eram) vidi cum matre legentem.
Alter ab undecimo tum me iam acceperat annus ;
iam fragiles poteram ab terra contingere ramos.
Ut vidi, ut perii, ut me malus abstulit error !

IV. (1) Explain the following :—amant alterna Camenae, flores inscripti nomina regum, damnabis tu quoque votis, satis est potuisse videri, lupi Moerim videre priores.

(2) What allusions do the Eclogues contain (1) to the circumstances of Virgil's personal history, and (2) to contemporary writers ?

V. Translate :—

THE GOLDEN AGE.

Aurea prima sata est aetas, quae vindice nullo,
Sponte sua, sine lege, fidem rectumque colebat.
Poena metusque aberant : nec verba minacia fixo
Aere legebantur : nec supplex turba timebant
Iudicis ora sui : sed erant sine vindice tuti.
Nondum caesa suis, peregrinum ut viseret orbem,
Montibus in liquidas pinus descenderat undas :
Nullaque mortales, praeter sua, litora norant.
Nondum praecipites cingebant oppida fossae :
Non tuba directi, non aeris cornua flexi,
Non galeae, non ensis, erant : sine militis usu
Mollia securae peragebant otia gentes.

LATIN.

SECOND PAPER.

Friday, 21st June 1889, 2—5.

CICERO, PRO SESTIO: LUCRETIUS, BOOK V.

I. Translate :—

Harum rerum tot atque tantarum esse defensorem et patronum magni animi est, magni ingenii magnaeque constantiae : etenim in tanto civium numero magna multitudo est eorum, qui aut propter metum poenae, peccatorum suorum conscii, novos motus conversionesque rei publicae quaerant, aut qui propter insitum quendam animi furorem discordiis civium ac seditione pascantur, aut qui propter implicationem rei familiaris communi incendio malint quam suo deflagrare. Qui cum tutores sunt et duces suorum studiorum vitiorumque nancti, in re publica fluctus excitantur, ut vigilandum sit eis, qui sibi gubernacula patriae depoposcerunt, enitendumque omni scientia ac diligentia, ut conservatis eis, quae ego paulo ante fundamenta ac membra esse dixi, tenere cursum possint et capere otii illum portum et dignitatis. Hanc ego viam, iudices, si aut asperam atque arduam aut plenam esse periculorum aut insidiarum negem, mentiar ; praesertim cum id non modo intellexerim semper, sed etiam praeter ceteros senserim. Maioribus praesidiis et copiis oppugnatur res publica quam defenditur, propterea quod audaces homines et perditi nutu impelluntur et ipsi etiam sponte sua contra rem publicam incitantur ; boni nescio quo modo tardiores sunt.

II. Translate :—

(*a*) Quod superest arvi, tamen id natura sua vi
Sentibus obducat, ni vis humana resistat
Vitai causa valido consueta bidenti
Ingemere et terram pressis proscindere aratris.
Si non fecundas vertentes vomere glebas
Terraique solum subigentes cimus ad ortus,
Sponte sua nequeant liquidas existere in auras,
Et tamen interdum magno quaesita labore

Cum iam per terras frondent atque omnia florent,
Aut nimiis torret fervoribus aetherius sol
Aut subiti peremunt imbres gelidaeque pruinae,
Flabraque ventorum violento turbine vexant.

(*b*) At claros homines voluerunt se atque potentes,
Ut fundamento stabili fortuna maneret
Et placidam possent opulenti degere vitam ;
Nequiquam, quoniam ad summum succedere honorem
Certantes iter infestum fecere viai,
Et tamen e summo, quasi fulmen, deicit ictos
Invidia interdum contemptim in Tartara taetra ;
Invidia quoniam, ceu fulmine, summa vaporant
Plerumque et quae sunt aliis magis edita cumque ;
Ut satius multo iam sit parere quietum
Quam regere imperio res velle et regna tenere.
Proinde sine incassum defessi sanguine sudent,
Angustum per iter luctantes ambitionis ;
Quandoquidem sapiunt alieno ex ore petuntque
Res ex auditis potius quam sensibus ipsis,
Nec magis id nunc est neque erit mox quam fuit ante.

III. Translate and comment on :—

(1) At nisi purgatumst pectus, quae proelia nobis
Atque pericula tumst ingratis insinuandum !

(2) Vagituque locum, lugubri complet, ut aequumst
Cui tantum in vita restet transire malorum.

(3) Nec pietas ullast velatum saepe videri
Vertier ad lapidem atque omnes accedere ad aras.

(4) Sic volvenda aetas commutat tempora rerum.
Quod fuit in pretio, fit nullo denique honore ;
Porro aliud succedit et e contemptibus exit.

IV. Explain and illustrate the use in Lucretius of the following :—
cretus, improbus, saeclum, daedalus, cor, boves Lucae, otia dia.

V. Write a short note on Lucretius's conception of the progress of human society.

W. P.

LOGIC.

Thursday, 13th June 1889 : 2—4 p.m.

1. Give (*a*) the Logical Opposites, and (*b*) the Converse of the Contradictory of—
   (1) Men are more to be trusted than we think.
   (2) Many a little makes a mickle.
   (3) Only the dead are happy.
2. What are the rules of correct definition ?
3. Define each of the five predicables.
4. What rules of the syllogism are broken by the moods AOE, IOI, III, EOO, and why is IEO always invalid ?
5. Examine the following arguments, and point out which are valid syllogisms, naming figure and mood, and reducing imperfect figures to the first figure ; in the case of such as are invalid name the rule which is broken, and give the name of the fallacy. Supply premises where necessary :—
   (1) He is not a Christian, for no Christian holds these views.
   (2) He must be a Christian, for all Christians hold these views.
   (3) No fool is fit for high place ; he is no fool, therefore he is fit for high place.
   (4) The use of spirituous liquors should be prohibited, for they tend to produce crime, and all crime should be prohibited.
   (5) Night must be the cause of day, for it invariably precedes it.
6. How are the strictly Inductive Methods frustrated, and how must that frustration be met ?
7. What are the comparative merits and demerits of the Methods of Agreement and Difference.
8. State with examples the three steps of the Deductive Method.
9. Explain shortly the expressions—a priori, a posteriori, summum genus, per genus et differentiam, reductio ad impossible, post hoc ergo propter hoc, argumentum ad hominem, non sequitur.

At least three of the last four questions should be attempted.

G. E.

ENGLISH LITERATURE (Lectures).

Monday, June 17.—6—8.30 p.m.

1. Give an account of the "Faery Queene"; and remark (1) on Spenser's English, and (2) on the Spenserian Stanza.
2. Indicate the stages in the development of the English Drama; name the leading Elizabethan Dramatists; and give *one* work by each author you mention.
3. Write a life of Shakespeare; and mention the leading characteristics of his genius.
4. Name the chief prose writers of the Elizabethan age; and give a careful account of the life and works of *any one* of them.
5. Remark on the literary style of the following writers:—Sir Thomas Browne, Thomas Fuller, Jeremy Taylor, Thomas Hobbes, Lord Clarendon, John Bunyan.
6. Group Milton's works according to the three periods into which his life is divided; and write a paragraph on his personal characteristics.
7. Add a descriptive note to each of the following names:—Drayton, Herrick, Cowley, Marvell, Herbert.

T. G.

ENGLISH LITERATURE (Class Readings).

Wednesday, June 19.—6—8.30 p.m.

1. Sketch the story of Shakespeare's "Hamlet"; and add a quotation or two, if you can.
2. Give a short account of Shakespeare's versification.
3. Mention, with illustrations, any peculiarities of Shakespeare's English.
4. Write a short Essay on Shakespeare's conception of Hamlet's character.
5. Remark on the following characters in the Play:—Polonius, Horatio, Ophelia.

6. Re-write the following passages in prose, adding notes, when necessary :—

(1) "Now, sir, young Fortinbras,
Of unimproved mettle hot and full,
Hath in the skirts of Norway here and there
Shark'd up a list of lawless resolutes,
For food and diet, to some enterprise
That hath a stomach in't."

(2) "Thus was I, sleeping, by a brother's hand
Of life, of crown, of queen, at once dispatch'd :
Cut off even in the blossoms of my sin,
Unhousel'd, disappointed, unaneled,
No reckoning made, but sent to my account
With all my imperfections on my head."

(3) "Sense sure you have,
Else could you not have motion ; but sure that sense
Is apoplex'd ; for madness would not err,
Nor sense to ecstasy was ne'er so thrall'd
But it reserved some quantity of choice,
To serve in such a difference. What devil was't
That thus hath cozen'd you at hoodman-blind ?"

(4) "The other motive,
Why to a public count I might not go,
Is the great love the general gender bear him ;
Who, dipping all his faults in their affection,
Would, like the spring that turneth wood to stone,
Convert his gyves to graces ; so that my arrows,
Too slightly timber'd for so loud a wind,
Would have reverted to my bow again,
And not where I had aim'd them."

(5) "Her obsequies have been as far enlarged
As we have warrantise : her death was doubtful ;
And, but that great command o'ersways the order,
She should in ground unsanctified have lodged
Till the last trumpet ; for charitable prayers,
Shards, flints and pebbles should be thrown on her :
Yet here she is allow'd her virgin crants,
Her maiden strewments and the bringing home
Of bell and burial."

T. G.

MODERN HISTORY.

Monday, June 17.—6 to 8.30 p.m.

I. Constitutional History of England.

1. Describe the leading Anglo-Saxon Institutions, and show how they were changed by the Norman Conquest.
2. Give the substance of the chief clauses of Magna Charta.
3. Write a short account of the growth of Government by Cabinet and explain the peculiarities of the Cabinet System.
4. Give the main provisions of the Reform Bills of 1832, 1867, and 1884.

II. History of England (449-1485).

1. Indicate generally the aims of Henry II. as a ruler; and mention the important results of his reign.
2. Remark on the following in Edward I.'s reign:—(1) Important Statutes; (2) Edward's relations with Scotland; (3) Edward's place in Parliamentary History.
3. Remark, under the following heads, on the social state of England in 1485:—(1) Political Condition of the Nation; (2) Effects of the Wars of the Roses; (3) Changes in the Lower Classes; (4) Influence of the Renascence; (5) Change in the Military System.
4. Add a descriptive note to each of the following names:—Alfred, Dunstan, Cnut, Anselm, Wiclif, Simon de Montfort, Flambard, Jack Cade, Langton, Godwine.

T. G.

ENGLISH COMPOSITION AND RHETORIC.

Monday, June 17.—6—8.30 p.m.

1. Define and exemplify *any six* of the Figures of Speech.
2. Discuss *Brevity* as a virtue of language; and mention, with examples, the main violations of this Quality.

3. Give an account of *Simplicity* as a Quality of Style.
4. Write a short Essay on Wit and Humour.
5. Mention the chief rules to be observed in the structure (1) of sentences, and (2) of paragraphs.
6. How may Historical Literature be sub-divided? Mention leading works in each sub-division.
7. State, explain, and illustrate the different methods of expounding general principles.
8. Give, under the following heads, a short account of English Versification:—(1) Metre; (2) Alliteration; (3) Rime; (4) Kinds of Verse.

T. G.

HISTORY OF THE ENGLISH LANGUAGE.

Wednesday, June 19.—6—8.30 p.m.

1. Give, with explanations, a careful account of Grimm's Law of Permutation of Consonants.
2. Mention, with illustrations, the chief effects of the Norman Conquest on the History of the English Language.
3. Classify Adverbs (1) according to their *meaning*, and (2) according to their *origin* or *form*; and illustrate as fully as you can.
4. Write out an alphabetical list of Romance Particles; indicate the meaning they have in composition with English words; and give a few examples under each.
5. Mention the chief differences between Chaucer's English and Modern English (1) in respect of *vocabulary*, and (2) in respect of *grammar*; and quote examples.
6. Give a philological account of the following words in the "Prologue":—"letuaries," "laas," "surgerye," "sethe," "cofre," "courtepy," "mewe," "lodemenage," "hoole," "taille."
7. Re-write in prose the following passages from Chaucer, adding illustrative notes, when necessary:—

(1) "Al ful of chirkyng was that sory place.
The sleere of himself yet saugh I there,
His herte-blood hath bathed al his here;

The nayl y-dryven in the schode a-nyght;
The colde deth, with mouth gapyng upright.
Amyddes of the temple sat meschaunce,
With disconfort and sory contenaunce.
Yet saugh I woodnesse laughying in his rage;
Armed complaint, outhees, and fiers outrage."

(2) "A Sergeant of Lawe, war and wys,
That often hadde ben atte parvys,
Ther was also, ful riche of excellence.
Discret he was, and of great reverence:
He semede such, his wordes weren so wise,
Justice he was ful often in assise,
By patente, and by pleyn commissioun;
For his science, and for his heih renoun,
Of fees and robes hadde he many oon.
So gret a purchasour was nowher noon.
All was fee symple to him in effecte,
His purchasyng mighte nought ben enfecte.
Nowher so besy a man as he ther nas,
And yit he seemede besier than he was.
In termes hadde he caas and domes alle,
That fro the time of kyng William were falle.
Thereto he couth endite, and make a thing,
Ther couthe no wight pynche at his writyng."

T. G.

CLASS FOR B.A. LONDON EXAMINATION.

(Honours English.)

Wednesday, June 19.—6—8.30 p.m.

1. Write a life of Spenser; and indicate the plan and general character of the "Faery Queene."
2. Write a criticism of Spenser's "Shepheardes Calender"; and give a careful account of *one* Eclogue in the poem.
3. Indicate the stages in the development of the English Drama; and mention, with critical comments, the names and chief works of Shakespeare's dramatic predecessors.

4. Remark (1) on Shakespeare's Minor Poems; (2) on his Sonnets; and (3) on his Humour.
5. Give a careful account of the life, chief works, and characteristics of Ben Jonson.
6. Give an account of Bacon's English Works; and remark on his style.
7. Write a paragraph on the literary importance of the Authorised Version of the Bible.
8. Add a *brief* descriptive note to each of the following names:—Ascham, Sidney, Drayton, Raleigh, William Browne, Sackville, Daniel, Gascoigne, Hooker, Drummond.
9. Sketch briefly the story of "Havelok the Dane."
10. Translate "Havelok the Dane," lines 2168—2187.
11. Translate Barbour's "Bruce," page 10, lines 225—248.
12. Translate Barbour's "Bruce," page 472, lines 203—226.

T. G.

ANGLO-SAXON OR OLD ENGLISH.

Monday, June 17.—6—8.30 p.m.

1. Decline together "se gōda mann."
2. Decline "til," "hwæt," and "halig."
3. Compare "strang," "eald," "heah," "gōd," "geong," "yfel," "micel," "feorr," "lytel," and "glæd."
4. Write out the present indicative of the following verbs:—"libban," "wesan," "witan," "nęrian," "nyllan," "dōn," "habban," "folgian," "lufian," "hīeran."
5. Give the principal parts of the following verbs:—"healdan," "fōn," "findan," "winnan," "giefan," "biddan," "seon," "flowan," "geliefan," "sęcgan."
6. Give, with their meanings, the chief Anglo-Saxon Terminations for Substantives and Adjectives; and illustrate as fully as you can.

7. Give a short account of the relics of Heathenism preserved in Anglo-Saxon Literature.

8. Mention the chief features of Anglo-Saxon Poetry; and sketch the story of "Beowulf."

9. Translate Sweet's Anglo-Saxon Primer, page 81, lines 61—86.

10. Translate Sweet's Anglo-Saxon Reader, pp. 46—7, lines 1—19 and 41—49.

T. G.

FRENCH AFTERNOON CLASS.

Wednesday, June 19, 1889.—10—12.30 p.m.

I. Traduisez en français :—

(*a*) Of his (Pope's) domestic character, frugality was a part eminently remarkable. Having determined not to be dependent, he determined not to be in want, and therefore wisely and magnanimously rejected all temptations to expense unsuitable to his fortune. This general care must be universally approved, but it sometimes appeared in petty artifices of parsimony, such as the practice of writing his compositions on the back of letters, as may be seen in the remaining copy of the "Iliad," by which perhaps in five years five shillings were saved; or in a niggardly reception of his friends, and scantiness of entertainment, as, when he had two guests in his house, he would set a single pint upon the table; and, having himself taken two small glasses, would retire and say, "Gentlemen, I leave you to your wine." Yet he tells his friends that "he has a heart for all, a house for all, and, whatever they may think, a fortune for all."

Johnson's Life of Pope.

FLOWERS.

(*b*) Spake full well, in language quaint and olden,
One who dwelleth by the castelled Rhine,
When he called the flowers, so blue and golden,
Stars, that in earth's firmament do shine.

Stars they are, wherein we read our history,
As astrologers and seers of eld;
Yet not wrapped about with awful mystery,
Like the burning stars, which they beheld.

Wondrous truths, and manifold as wondrous,
God hath written in those stars above;
But not less in the bright flowerets under us
Stands the revelation of his love.

Bright and glorious is that revelation,
Written all over this great world of ours;
Making evident our own creation,
In these stars of earth—these golden flowers.

And the Poet, faithful and far-seeing,
Sees, alike in stars and flowers, a part
Of the self-same universal being,
Which is throbbing in his brain and heart.

Longfellow.

II. Traduisez en anglais :—

LA POÉSIE.

(*a*) Chasser tout souvenir et fixer la pensée,
Sur un bel axe d'or la tenir balancée,
Incertaine, inquiète, immobile pourtant ;
Eterniser peut-être un rève d'un instant ;
Aimer le vrai, le beau, chercher leur harmonie ;
Ecouter dans son cœur l'écho de son génie ;
Chanter, rire, pleurer, seul, sans but, au hasard ;
D'un sourire, d'un mot, d'un soupir, d'un regard,
Faire un travail exquis, plein de crainte et de charme,
Faire une perle d'une larme :
Du poète ici-bas voilà la passion,
Voilà son bien, sa vie et son ambition.

A. De Musset.

LES MATÉRIAUX DE L'HISTOIRE.

(*b*) Les *Mémoires* et les Chroniques ne sont pas en général aussi sûrs à consulter qu'agréables à lire. L'historien doit s'en servir avec une extrême circonspection. *Écrits* ordinairement dans un but, longtemps après que les événements qu'ils exposent se sont *accomplis*, ils sont rarement exacts. Les auteurs savent mal ce qu'ils racontent, s'ils y sont demeurés étrangers ; et racontent mal ce qu'ils savent, s'ils sont intéressés à le taire ou à l'altérer. Quand ils ne sont pas imparfaitement instruits, ils sont volontairement partiaux. Les personnages qui ont *figuré* sur la scène de l'histoire y grossissent ou y dénaturent après coup leur rôle, et ils se parent en quelque sorte devant la postérité pour la séduire, en arrangeant leur conduite d'aprés les événements, et en se donnant plus de prévoyance et d'habileté qu'ils *n*'en ont *eu*. Aussi les Mémoires écrits dans le même temps et sur les mêmes choses sont peu d'accord, s'ils sont nombreux. La vérité est moins facile à y trouver que dans les pièces faites au moment même où les événements se passent, et destinées à les préparer, à les accomplir, à les

raconter. Ces sortes de documents ne plaisent pas toujours autant que les Mémoires, mais ils trompen moins. Ils sont les vrais matériaux de l'histoire. Ceux dont ils émanent n'ont pas songé à paraître, mais à agir. Aussi les pièces écrites avant, pendant et après l'action en donnent à la fois les éléments et les motifs, transmettent les faits dans leur certitude, les intentions dans leur réalité. L'histoire s'avance sûrement lorsqu'elle s'appuie sur elles. C'est à leur clarté qu'elle suit la marche des événements et qu'elle pénètre les desseins des hommes.

Mignet.

III. Grammaire :—

(*a*) 1. *Mémoires.* Remarque sur le genre de ce mot.

2. *Ecrits* ordinairement . . . se sont *accomplis* . . . qui ont *figuré* . . . qu'ils n'en ont *eu.* Expliquez l'accord de ces participes.

3. Dans quel cas le part. précédé de *en* est-il variable ?

4. Expliquez l'emploi de *ne* dans *n'en ont eu.*

(*b*) 1. Comment distingue-t-on les mots d'origine populaire, des mots d'origine savante ?

2. Quels sont les éléments étrangers entrés dans la composition de la langue française ?

3. Expliquez la formation du pluriel en *s.*

IV. Littérature.

Analysez le Roman de la Rose.

H. D.

EVENING CLASSES.

JUNIOR MATHEMATICS

1. From the number of permutations of n things taken altogether, deduce the number when only r of them are taken at a time. Find the number of permutations of the letters in *Cumberland*, *correspondence*, *disappearance*, *Salamanca*.

2. Sum to 100 terms the series (1) $1.2 + 2.3 + 3.4 +$ &c.

   (2) $1^2+2^2+3^2+$ &c., and to n terms the series $a + \frac{a}{r} + \frac{a}{r^2} +$ &c.

3. Show that $1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+$ &c. to ∞ lies between $\frac{3}{4}$ and $\frac{4}{5}$.

4. Define the logarithm of a number. Prove that $\log x - \log y = \log \frac{x}{y}$ In the common system $\log 2 = \cdot 301030$, find the logs of 4, 5, 8, and 800.

5. Define the sine and cosine of an angle, and prove that whatever A be, $\sin^2 A + \cos^2 A = 1$.

6. Define the tangent and secant of an angle. If the tangent of an angle is $\frac{3}{4}$, find its sine and its secant.

7. In any triangle show that the sides are proportional to the sines of the opposite angles.

8. Prove that $\sin (A+B) = \sin A \cos B + \cos A \sin B$.

9. Find the area of the triangle in which $x_1\ y_1$, $x_2\ y_2$ are the extremities of the base, and whose vertex is the origin.

10. Find the equation to a straight line in terms of the intercepts it makes with the axes, and find the length of the perpendicular on it from the origin.

11. Find the centre and radius of the circle $x^2+y^2-4y=0$, and find where the line $y=x/\sqrt{3}$ cuts it and the length of the chord. Give a diagram.

J. M. C.

SENIOR MATHEMATICS

1. Explain fully the terms *function, implicit function, variable, independent variable.*

2. When is a function said to be continuous: discuss with regard to continuity the functions 2^x, $\frac{1}{x}$, $\log x$.

3. Define the terms *limit, infinite.* Find the limit of $\frac{\tan x}{x}$ when $x=0$: discuss the limit when $x=\frac{1}{2}n$.

4. Define as a limit the differential coefficients of a function. Deduce from the definition the differential coefficients of
$$x^n, \quad \sqrt{1+x^2}, \quad \text{and} \quad \tan^{-1} x.$$

5. Find $\frac{dy}{dx}$ when (1) $y=\sin^n x$, (2) $y=x^n \log x$
(3) $y=\sin x. \sqrt{a+bx+cx^2}$.

6. Show that $f(x+h)=f(x)+h f'(x+\theta h)$, where θ is a proper fraction. Illustrate this geometrically.

7. Prove that $f(x)=f(0)+x f'(0)+\frac{x^2}{1.2} f''(0)+$ &c., explaining carefully the notation $f^n(0)$.

8. Expand $\log(1+x)$ in ascending powers of x, and $\log\frac{1+x}{x}$ in descending powers of x. Can the latter function be expanded in ascending powers of x?

J. M. C.

PHYSICAL LABORATORY

(This paper was set for evening and Saturday students.)

WRITTEN EXAMINATION

1. How would you divide a vernier so as to read minutes on a circular scale graduated in half degrees?

2. Shew by a diagram how you would arrange a convex lens of known focus, a concave lens of shorter but unknown focus, a slit, a flame, and a screen so as to determine the focal length of the concave lens by a single experiment.

3. What methods may be used to obtain the steam dry in measuring its latent heat?

PRACTICAL EXAMINATION

(Three questions to be attempted, one in each group)

A

1. Find the value of the acceleration of gravity by means of the pendulum.
2. Determine the specific gravity of mercury.
3. Find the specific gravity of the given piece of wax.
4. Plot the curve of extension obtained from the stretching of an india-rubber cord.
5. Find the coefficient of friction between iron and mahogany.
6. Measure the thicknesses of the two given pieces of glass together and separately by the wire gauge and spherometer.

B

1. Find the focal length of the given mirror.
2. Measure the three angles of the prism.
3. Find the focal length of the concave lens.
4. Measure the curvature of the given lens.

C

1. Find the specific heat of mercury.
2. Find the curve of cooling of water.
3. Obtain the coefficient of expansion of mercury.
4. Find the latent heat of steam.
5. Determine the melting point of wax.

J. E. A. S.

ANALYTICAL CLASS (LECTURES).

March 15th, 1889—7 to 9 p.m.

(Give equations where possible).

1. A powder on heating on charcoal with Na_2CO_3
   (*a*) Gave a malleable bead,
   (*b*) Deflagration occurred,
   (*c*) On moistening with $CoCl_2$ the mass became green,
   (*d*) On transferring some of the heated mass to a silver coin, and adding water, a black stain was left on the coin.

   Of what may the powder consist, and what confirmatory tests would you employ?
2. Give the special tests employed for (*a*) Arsenic, (*b*) Manganese, and (*c*) Chromium.
3. Write out a table showing the differences between (*a*) Mercurous and Mercuric Salts, (*b*) Stannous and Stannic Salts, and (*c*) Bismuthyl Chloride and Antimonyl Chloride.
4. Give tests for the following acids :—(*a*) Phosphoric, (*b*) Sulphurous, (*c*) Thiosulphuric, (*d*) Hydrofluoric, and (*e*) Boric.
5. Clearly explain why it is necessary (*a*) to ignite in the potassium group before testing for potassium, (*b*) to add HCl before $BaCl_2$ in testing for H_2SO_4, (*c*) to add NH_4Cl in the iron group, (*d*) to add HCl in the copper group, and (*e*) to digest with $(NH_4)_2S$ in the copper group.
6. Classify the following as (*a*) insoluble in HCl, (*b*) soluble in HCl but insoluble in water, and (*c*) soluble in water :—K_2S, $Ca(OH)_2$, MnS, PbS, $Al_2(OH)_6$, As_2S_3, Ag_2S, $Mg(OH)_2$, FeS, BaS, SrS, CoS, CuS, SnS, $Cr_2(OH)_6$.

A. T.

THE CHEMISTRY OF THE TEXTILE FIBRES.

March, 1889.

1. State what you know in regard to the reactions and properties of Cellulose. What is its relation to the Textile Fibres?
2. Classify the Textile Fibres, and give examples of each class.

3. What tests would you employ to distinguish between a Pecto-Cellulose and a Ligno-Cellulose?
4. State fully and clearly the objects of Sizeing, and note some of the more important points to be attended to in order to avoid Mildew.
5. What are the differences in the physical structure of Cotton, Wool, Silk, and Jute? Point out the influence which these differences have on the manufacture, &c., of these Fibres.

T. C.

ORGANIC CHEMISTRY.

1. What is a *ketone?* Give two general methods for the preparation of ketones.
2. Give the constitutional formulæ of the following bodies :—
   (*a*) Normal primary propylalcohol;
   (*b*) Isopropylalcohol.
   (*c*) Normal secondary butylalcohol.
   (*d*) Tertiary butylalcohol.
3. What is an *olefine?* How may an olefine be converted into a dihydric alcohol?
4. What is the composition of common lactic acid, and how is it prepared from sugar?
5. Give some account of optical activity and its connection with chemical constitution.

P. F. F.

ENGINEERING DRAWING.

Machine Design.

(Six Questions only to be answered. Students of Valve Gearing to restrict themselves to Questions 1, 4, 5, 6, 7, 8, 9).

1. Design a steel valve spindle for the slide valve sketched. Steam pressure 150 lbs. per sq. inch. Scale, full size.
2. What length would you make the main bearings for a double webbed crank shaft, 8″ diameter? The engine to be of the vertical, high-pressure, condensing type, with a single inverted cylinder, 20″ diameter. Working pressure 100 lbs. per sq. inch.
3. Give reasons for and against the use of four main-bearing bolts. What diameter of steel bolts would be required for the main-bearing (Q. 2) if four bolts were used.
4. Explain the terms lap, lead, and angular advance of eccentric. What influence has the connecting-rod on the distribution of steam in a cylinder?
5. Work out the dimensions of the steam and exhaust ports, and the opening to steam for an engine running 50 revolutions per minute. Cylinder, 20″ diameter; stroke, 30″.
6. What conditions should a good valve gear fulfil? 1st, with reference to the gear considered mechanically; 2nd, as regards the distribution of steam.
7. The reciprocating parts of an engine knock heavily at the end of every stroke; how would you stop this?
8. How would you correct the defects in the steam distribution as shown by the indicator cards supplied?
9. What effect on the steam distribution has the linking up of a Stephenson's link-motion; and how can the distribution of steam be found for any position of the link?

T. R.

ENGINEERING.

March, 1889.

Strength of Materials.

(*Ten Questions only to be answered*).

1. Describe very shortly the Bessemer process of steel-making.
2. Distinguish between mild steel and high carbon steel as regards method of manufacture, mechanical quality, capability of tempering, and uses.
3. Explain the advantage of successive rollings in the manufacture of wrought-iron plates or bars.
4. Define Young's modulus of elasticity, and say in what units it may be expressed.
5. Sketch typical stress-strain diagrams for cast-iron, wrought-iron, and mild steel.
6. What is meant by the fatigue of metals under variation of stress.
7. What are the principal considerations that have to be borne in mind in choosing factors of safety.
8. Sketch, with dimensions, the diagram of bending moments for a beam 20 feet long, loaded with 1 ton at 8 feet, and 2 tons at 12 feet, from one end.
9. Show how to find the greatest intensity of stress in the beam of question 8, if you knew the form of the section.
10. Sketch the reciprocal figure or diagram of forces for an ordinary king-post roof, carrying equal loads at each top joint.
11. Explain the use of double diagonals or semi-members in the cross bracing of a bridge frame.
12. In a boiler 12 feet in diameter the pressure is 150 lbs. per square inch, and the thickness of the plate is 1 inch. Find the intensity of tensile stress in the plates.

J. A. E.

PHYSIOLOGY.

6—7 p.m.

1. What is the essential nature of the process of respiration? What changes take place in the tissues, and what in the blood?
2. Give a short account of mechanical adaptations for strength in the skeleton.
3. Describe the structure of the eye so far as to explain the mechanism of focal accommodation.

D. W. T.

BOTANY.

(Four Questions only to be answered).

1. Some people put red and others blue glass in greenhouses. What did we find experimentally to be the result in each case?

2. We classified Dicotyledons as Thalamifloræ, Calycifloræ, Corollifloræ, and Incompletæ. State the leading characteristics of these groups, and mention two common representatives of each.

3. Give an account of the ascent of the sap.

4. What is the essential process of fertilisation of all flowers? Describe a case in which this is brought about (*a*) by wind, (*b*) by an insect.

5. What do you understand by *artificial selection*, and what by *natural selection*.

P. G.

JUNIOR LATIN.

I.

I. Virgil, Aeneid I.—Lines 1—253.

1. Translate into English :—

(*a*) Urbs antiqua fuit,—Tyrii tenuere coloni,—
Karthago, Italiam contra Tiberinaque longe
ostia, dives opum studiisque asperrima belli ;
quam Iuno fertur terris magis omnibus unam
posthabita coluisse Samo : hic illius arma,
hic currus fuit ; hoc regnum dea gentibus esse
siqua fata sinant, iam tum tendique fovetque.
Progeniem sed enim Troiano a sanguine duci
audierat, Tyrias olim quae verteret arces ;
hinc populum late regem belloque superbum
venturum excidio Libyae : sic volvere Parcas.

(*b*) Haec ubi dicta, cavum conversa cuspide montem
impulit in latus : ac venti, velut agmine facto,
qua data porta, ruunt et terras turbine perflant.
Incubuere mari, totumque a sedibus imis
una Eurusque Notusque ruunt creberque procellis
Africus, et vastos volvunt ad litora fluctus.
Insequitur clamorque virum stridorque rudentum.
Eripiunt subito nubes caelumque diemque
Teucrorum ex oculis ; ponto nox incubat atra.
Intonuere poli et crebris micat ignibus aether,
praesentemque viris intentant omnia mortem.

(*c*) Est in secessu longo locus : insula portum
efficit obiectu laterum, quibus omnis ab alto
frangitur inque sinis scindit sese unda reductos.
Hinc atque hinc vastae rupes geminique minantur
in caelum scopuli, quorum sub vertice late
aequora tuta silent : tum silvis scaena coruscis
desuper horrentique atrum nemus imminet umbra ;
fronte sub adversa scopulis pendentibus antrum,
intus aquae dulces vivoque sedilia saxo,
nympharum domus : hic fessas non vincula navis
ulla tenent, unco non alligat ancora morsu.

(*d*) 'O socii, neque enim ignari sumus ante malorum
o passi graviora, dabit deus his quoque finem.
Vos et Scyllaeam rabiem penitusque sonantis
accestis scopulos, vos et Cyclopea saxa
experti : revocate animos, maestumque timorem
mittite ; forsan et haec olim meminisse iuvabit.
Per varios casus, per tot discrimina rerum
tendimus in Latium, sedes ubi fata quietas
ostendunt ; illic fas regna resurgere Troiae.
Durate, et vosmet rebus servate secundis.'

2. In (*a*) parse dives, fertur, opum, fovet, sanguine, duci, volvere ; and comment on the cases of terris, bello, excidio, and the tense and mood of esse (l. 17), sinant, verteret, volvere.

3. In (*b*) scan lines 84—89.

4. In (*c*) comment on the cases of harena, sale, silici, undis, rerum ; and give the principal parts of all the verbs.

5. In (*d*) explain all the allusions *fully*.

6. Translate into Latin :—

1. What sort of man is Verres whom Cæsar has accused ?
2. We have heard that the wolves are running through the middle of the town.
3. Having given the signal, the General led his forces from the camp across the river.
4. A great storm having arisen, the ships were thrown upon the rocks.
5. The Consul says that he has drawn up his line of battle on the top of the hill.
6. With Aeneas for leader, the Trojans suffered very many hardships before they arrived in Italy.
7. The robbers, by whom the judge's daughter has been wounded, must be put to death.
8. The old man who says that Cæsar wrote the letters must not be believed.
9. We have been easily persuaded by Marcus.
10. Who does not believe that the earth is larger than the moon ?

JUNIOR LATIN.

II.

Roman History.

1. Sketch the career of *either* (α) Marius : *or* (β) Pompeius : *or* (γ) Cicero.

2. Add a very short note to each of the following names :—Clodius, Aquae Sextiae, C. Gracchus, Sertorius, Vercingetorix, Saturninus, Sulla, Catiline, Sulpicius, Verres.

3. Give a brief outline of the course of events from the assassination of Julius Cæsar (B.C. 44) to the Battle of Actium (B.C. 31).

SENIOR LATIN.

I.

I. Translate :—

Romæ ad primum nuntium cladis eius cum ingenti terrore ac tumultu concursus in forum populi est factus : matronae vagae per vias, quae repens clades allata quaeve fortuna exercitus esset, obvios percunctatur ; tandem haud multo ante solis occasum M. Pomponius praetor "Pugna," inquit, "magna victi sumus :" et quanquam nihil certius ex eo auditum est, tamen alius ab alio impleti rumoribus referunt, consulem cum magna parte copiarum caesum, superesse paucos aut fuga passim per Etruriam sparsos aut captos ab hoste. Senatum praetores per dies aliquot ab orto usque ad occidentem solem in curia retinent, consultantes, quonam duce aut copiis quibus resisti victoribus Poenis posset.

II. Translate into Latin :—

1. When his opinion was asked he made no reply.

2. The messenger, who had come to Rome with the greatest speed, told the General that the cavalry were now crossing the river with the intention of attacking the troops under his command.

3. Unless he receives a letter from us, I have no doubt he will remain there during the winter.

4. The king having asked why against the law of nations he had dared so great a crime, the youth answered that there was no deed which he would not dare for the safety of his country.

5. Certain authors relate that Xerxes, King of the Persians, after reviewing the army which he was about to lead against Greece, shed copious tears, because no one out of so many thousands would be alive after a hundred years.

6. Sulla, when consul, after driving Marius into exile, set out against Mithridates ; and having routed him in many battles, he concluded peace on these conditions, that the King should leave Asia alone, as well as the other provinces which he had seized, and should be contented with his paternal territory.

SENIOR LATIN.

II.

13th March 1889.

I. Translate :—

Considunt transtris, intentaque bracchia remis ;
intenti expectant signum, exultantiaque haurit
corda pauor pulsans laudumque arrecta cupido.
inde ubi clara dedit sonitum tuba, finibus omnes,
haut mora, prosiluere suis : ferit aethera clamor
nauticus, adductis spumant freta uersa lacertis.

(α) Parse *intenta, corda, arrecta, prosiluere, lacertis, versa.*

(β) Scan the first three lines.

II. Translate :—

At matres primo ancipites oculisque malignis
ambiguae spectare rates miserum inter amorem
praesentis terrae fatisque vocantia regna :
cum dea se paribus per caelum sustulit alis
ingentemque fuga secuit sub nubibus arcum.
tum vero attonitae monstris actaeque furore
conclamant, rapiuntque focis penetralibus ignem,
pars spoliant aras, frondem ac virgulta facesque
coniciunt. furit inmissis Volcanus habenis
transtra per et remos et pictas abiete puppis.

nuntius Anchisae ad tumulum cuneosque theatri
incensas perfert navis Eumelus, et ipsi
respiciunt atram in nimbo volitare favillam.
primus et Ascanius, cursus ut laetus equestris
ducebat, sic acer equo turbata petivit
castra, nec exanimes possunt retinere magistri.

Parse *ancipites, spectare, sustulit, secuit, inmissis, pictas.*

III. Give the meaning of the following:—Ore favete omnes, voti reus, exsortem ducere honorem, Italiam sequimur fugientem, lentusque carinas est vapor, datur hora quieti, Iliacis exercite fatis, urbem designat, aratro, corripiunt spatia, possunt quia posse videntur.

IV. Translate and write a very brief note on each of the following:—

(1.) Hinc maxuma porro
Accepit Roma, et patrium servavit honorem;
Troiaque nunc pueri. Troianum dicitur agmen.

(2.) Quidquid erit, superanda omnis fortuna ferendo est.

(3.) Gratior et pulchro veniens in pectore virtus.

(4.) Proxumus hinc longo sed proxumus intervallo.

(5.) Non vires alias conversaque numina sentis?

(6.) Indicit forum et patribus dat jura vocatis.

W. P.

LOGIC.

(*For Examination Paper, see page* 301).

GREEK.

Xenophon Anabasis, I., Chaps. I—VII.

I. Translate:—

Καὶ οἱ μὲν ὄνοι, ἐπεί τις διώκοι, προδραμόντες [ἂν] ἔστασαν· πολὺ γὰρ τῶν ἵππων ἔτρεχον θᾶττον· καὶ πάλιν, ἐπεὶ πλησιάζοιεν οἱ ἵπποι, ταὐτὸν ἐποίουν· καὶ οὐκ ἦν λαβεῖν, εἰ μὴ διαστάντες οἱ ἱππεῖς θηρῷεν διαδεχόμενοι τοῖς ἵπποις. Τὰ δὲ κρέα τῶν ἁλισκομένων ἦν παραπλήσια τοῖς ἐλαφείοις, ἀπαλώτερα δέ. Στρουθὸν δὲ οὐδεὶς ἔλαβεν· οἱ δὲ διώξαντες τῶν ἱππέων ταχὺ ἐπαύοντο· πολὺ γὰρ ἀπέσπα φεύγουσα, τοῖς μὲν ποσὶ δρόμῳ, ταῖς δὲ πτέρυξιν αἴρουσα ὥσπερ ἱστίῳ χρωμένη. Τὰς δὲ ὠτίδας, ἂν τις ταχὺ ἀνιστῇ, ἔστι λαμβάνειν· πέτονται γὰρ βραχύ, ὥσπερ πέρδικες, καὶ ταχὺ ἀπαγορεύουσι.

Parse and give principal parts of *ἔτρεχον, ἔστασαν, θηρῷεν, αἴρουσα, κρέα.*

II. Translate :—

Ταύτῃ δὲ τῇ γνώμῃ ἔφη καὶ τοὺς ἄλλους προσθέσθαι. Μετὰ ταῦτα, ἔφη, κελεύοντος Κύρου ἔλαβον τῆς ζώνης τὸν Ὀρόντην ἐπὶ θανάτῳ ἅπαντες ἀναστάντες καὶ οἱ συγγενεῖς· εἶτα δὲ ἐξῆγου αὐτὸν οἷς προσετάχθη. Ἐπεὶ δὲ εἶδον αὐτὸν οἷπερ πρόσθεν προσεκύνουν, καὶ τότε προσεκύνησαν, καίπερ εἰδότες, ὅτι ἐπὶ θάνατον ἄγοιτο. Ἐπεὶ δὲ εἰς τὴν Ἀρταπάτου σκηνὴν εἰσηνέχθη τοῦ πιστοτάτου τῶν Κύρου σκηπτούχων, μετὰ ταῦτα οὔτε ζῶντα Ὀρόντην οὔτε τεθνηκότα οὐδεὶς εἶδε πώποτε, οὐδὲ ὅπως ἀπέθανεν οὐδεὶς εἰδὼς ἔλεγεν· εἷς καζον δὲ ἄλλος ἄλλως· τάφος δὲ οὐδεὶς πώποτε αὐτοῦ ἐφάνη.

III. Translate and comment on words underlined :—

(α) *ὁ Κῦρος ἀπέπεμπε τοὺς γιγνομένους δάσμοὺς βασιλεῖ ἐκ τῶν πόλεων ὧν Τισσαφέρνους ἐτύγχανεν ἔχων.*

(β) *ἀπέκτεινε φοινικιστὴν βασίλειον, καὶ ἑτερόν τινα τῶν ὑπάρχων δυνάστην, αἰτιασάμενος ἐπιβουλεύειν αὐτῷ.*

(γ) *πρίασθαι οὐκ ἦν εἰ μὴ ἐν τῇ Λυδίᾳ ἀγορᾷ ἐν τῷ Κύρου βαρβαρικῷ, τὴν καπίθην ἀλεύρων ἢ ἀλφίτων τεττάρων σίγλων.*

IV. Give the constructions with *ὥστε, ὅπως,* and *ἄν.*

V. Give the meaning of and notes on *ὄνους ἀλέτας, κατάγειν, τοὺς φεύγοντας, τῶν οἴκοι ἀντιστασιωτῶν, σταθμός.*

VI. State something about Parysatis, Epyaxa, Menon, Clearchus, Abrocomas, Orontes.

VII. Translate into Greek :—

(1) And seeing the other lying in silence and in a most miserable state, "Come now," he said, "my dear friend, how are you?"

(2) Never mind about the talents, for your brother explained everything to me, and I pity you as much as possible, being in want of all that money.

(3) Stranger, it is plain to me that your brother is diseased in his head; for there is a sort of madness such as that; the man is often in other respects sensible, but about one thing he is out of his mind.

ENGLISH LITERATURE (Evening Class).

Thursday, March 14, 8—10.30 p.m.

(History of English Poetry from 1625 to 1688).

1. Write two paragraphs on the characteristics of the literature o the Restoration.
2. Write a short life of Milton.
3. Explain the *plan* of "Paradise Lost"; and show its connexion with the Ptolemaic astronomy.
4. Remark carefully on Milton's English.
5. Give, under the following heads, a short account of Dryden's chief works and characteristics as a writer:—(1) Dramas; (2) Satires; (3) Didactic Poems; (4) Miscellaneous Poems; (5) Translations and Adaptations.
6. Add a descriptive note to *any five* of the following names:—Waller, Habington, Randolph, Suckling, Samuel Butler, Denham, Cowley, Marvell, Vaughan, Otway.
7. Annotate the following passages from "Paradise Lost":—

(1) "Nine times the space that measures day and night
To mortal men, he, with his horrid crew,
Lay vanquished, rolling in the fiery gulf,
Confounded, though immortal."

(2) "In bulk as huge
As whom the fables name of monstrous size,
Titanian or Earth-born, that warred on Jove,
Briareos or Typhon, whom the den
By ancient Tarsus held, or that sea-beast
Leviathan, which God of all his works
Created hugest that swim the ocean-stream."

(3) "The broad circumference
Hung on his shoulders like the moon, whose orb
Through optic glass the Tuscan artist views
At evening, from the top of Fesolè,
Or in Valdarno, to descry new lands,
Rivers, or mountains, in her spotty globe."

(4) "They but now who seemed
In bigness to surpass Earth's giant sons,
Now less than smallest dwarfs, in narrow room
Throng numberless—like that pygmean race
Beyond the Indian mount."

(5) "As when far off at sea a fleet descried
Hangs in the clouds, by equinoctial winds
Close sailing from Bengala, or the isles
Of Ternate and Tidore, whence merchants bring
Their spicy drugs; they on the trading flood,
Through the wide Ethiopian to the Cape,
Ply stemming nightly toward the pole: so seemed
Far off the flying Fiend. At last appear
Hell-bounds, high reaching to the horrid roof,
And thrice threefold the gates; three folds were brass,
Three iron, three of adamantine rock,
Impenetrable, impaled with circling fire,
Yet unconsumed."

T. G.

MODERN HISTORY.

Constitutional History of England.

Friday, December 14th—7—9.30 p.m.

1. Give as careful an account as you can of the chief political institutions of the Anglo-Saxons.
2. Give the substance of the clauses of Magna Charta which affect the English Constitution and the administration of justice.
3. State clearly what part was played in the formation of the English Parliament (1) by Simon de Montfort, and (2) by Edward I.
4. Mention the chief provisions of the Bill of Rights.
5. Give the main provisions of the Reform Bills of 1832, 1867, and 1884.
6. Narrate briefly the History of Religious Liberty in England, especially since the Revolution of 1688.
7. Explain the following: — Trinoda necessitas, fyrd, wergild, bocland, presentment of Englishry, Curia Regis, frankpledge, suspending power, Septennial Act, feudal tenure.

T. G.

ENGLISH COMPOSITION AND RHETORIC.

Monday, March 11.—8—10.30 p.m.

1. Define and exemplify *any six* of the Figures of Speech.
2. Give an account of *Simplicity* as a Quality of Style.
3. Explain and illustrate the following statement:—"Purity of Style is consistency with the reputable, national, present use."
4. Write a short Essay on the *Pathetic in Literature;* and illustrate by quotation and reference to famous instances.
5. Mention, with examples, the principal points to be remembered in the structure of sentences.
6. Show how books may be classified; give Dr Arnold's definition of History; and mention, with examples, the sub-divisions of Historical Literature.

T. G.

FRENCH.

March 11, 1889.—8—10.

I. Translate into French, and refer to rule for the words in italics :—

(1) The Queen has bought a collection of *fans*. (2) My brother has received a *glass inkstand*. (3) Give the poor man *some* bread and meat. (4) *Ancient* history is interesting. (5) The *avenging* hand of justice punished the guilty. (6) The *royal* palaces are beautiful. (7) He has spent a third of his fortune. (8) The Protestants were murdered in Paris in the year one *thousand* five hundred and seventy-two. (9) The temper of *this* child is bad, but the temper of that child is worse still.

II. Translate into French :—

(*a*) Dionysius, the celebrated tyrant of Syracuse, was incessantly tormented by conspiracies formed against his throne and person. In the midst of his fears a stranger presented himself at a public levee, and told the monarch he knew a secret by means of which he might easily discover any conspiracy directed against him, and that for a certain sum of money he would reveal it to him. Dionysius promised to pay the man what he asked ; upon which the latter, taking the king aside, told him "I do not possess any secret ; but if you tell your subjects that I have revealed to you one that is infallible, no one henceforth will dare to conspire against you." Dionysius thought the advice excellent, adopted it, and lived tranquilly afterwards.

(*b*) Unseen :

A certain khan of Tartary, making a progress with his nobles, was met by a dervis, who cried with a loud voice, "Whoever will give me a hundred pieces of gold I will give him a piece of advice." The khan ordered him the sum, upon which the dervis said, "Begin nothing of which thou hast not well considered the end." The courtiers upon hearing this plain sentence, smiled, and said with a sneer, "The dervis is well paid for his maxim." But the king was so well satisfied with the answer, that he ordered it to be written in golden letters in several places of his palace, and engraved on all his plate.

(*c*) Is the electric fluid only diffused in the atmosphere? No. The electric fluid does not exist only in the air, it is diffused on the surface of most bodies : it suffices to rub them for this fluid to manifest its presence, either by sparks or by attracting light substances. Thus, if you rub the back of a cat in the dark you will see sparks escaping from this part of its body. If you rub a piece of sealing wax on a piece of cloth and bring it near some light substances, such as bits of paper, &c., it will attract these substances.

III. Translate into English :—

Dundee, le 11 Mars 1889.

(*a*) Messieurs J. L. SMITH & Cie, Négociants,
155, Fenchurch Street, à Londres.

J'ai l'honneur de vous annoncer que je viens de fonder dans cette ville une maison de commission pour l'achat et l'expédition des articles de Paris et des principales villes manufacturières de France.

Chargé durant plusieurs années, par une des premières maisons de cette ville, de faire spécialment ses achats dans les fabriques, j'ai eu depuis longtemps des rapports avec les fabricants dont les articles sont les plus recherchés et les plus avantageux, tant sous le rapport de la qualité que de la modicité des prix.

Je mets à votre disposition les connaissances et l'expérience que j'ai acquises dans ce genre d'affaires, et vous prie de croire au zèle et à l'activité que je porterai dans l'exécution de vos ordres.

J'ai l'honneur d'être, Monsieur, votre très obéissant serviteur,

F. G. PARIS.

LE VOYAGEUR À PIED.

(*b*) Je ne *conçois* qu'une manière de *voyager* plus agréable que *d'aller* à cheval, c'est d'aller à pied. On *part* à son moment, on *s'arrête* à sa volonté, on fait tant et si peu d'exercice qu'on *veut*. On observe tout le pays et on se détourne à droite, à gauche ; on examine tout ce qui nous flatte ; on s'arrête à tous les points de vue. Aperçois-je une rivière, je la côtoie ; un bois touffu, je vais sous son ombre ; une grotte, je la visite ; une carrière, j'examine les minéraux. Partout où je me plais, j'y reste. A l'instant que je m'ennuie, je m'en vais. Je ne *dépends* ni des chevaux ni du postillon. Je n'ai pas basoin de

choisir des chemins tout faits, des routes commodes, je passe partout où un homme *peut* passer; je *vois* tout ce qu'un homme peut voir, et, ne dépendant que de moi-même, je jouis de toute la liberté dont un homme peut jouir.

J. J. ROUSSEAU.

IV. Grammar Paper :—

(*a*) 1. Give the primitive tenses of the verbs in italics :—*Conçois, voyager, daller, part, s'arrête, veut, dépends, choisir, peut, vois.*

2. Give the nouns in *ou* which form their plural in *x*.

3. Translate in the masculine and feminine singular :— *deceitful, proud, dumb, discreet, old, dry, avenger, false.*

4. Compare *bon, petit, mauvais,* and the corresponding adverbs.

5. What is the difference between *ce* adjective and *ce* pronoun ; give instances.

(*b*) 1. Give the plural of *quiproquo, te deum, allegro, coffre-fort,* and refer to rule in each case.

2. When do proper names of persons take the mark of the plural ? Instances.

3. When does the adjective placed after two or more nouns agree with the last only ? Instances.

V. Translate into English :—

Unseen :

L'ART DE LIRE LES VERS.

C'est peu d'aimer les vers, il les faut savoir lire,
Il faut avoir appris cet art mélodieux
De parler dignement le langage des Dieux,
Cet art qui, par les sons des phrases cadencées,
Donne de l'harmonie et du nombre aux pensées,
Cet art de déclamer, dont le charme vainqueur
Assujettit l'oreille et subjugue le cœur.
Hé quoi ! d'une lecture insipide et glacée
Tu prétends attrister mon oreille lassée
Va, les traits que la Muse éternise en ses chants,
Récités avec art, en seront plus touchants :
Ils laisseront dans l'âme une trace durable,
Du génie éloquent empreinte inaltérable ;

Et rien ne plaira plus à tous les goûts divers
Qu'un organe flatteur déclamant de beaux vers.

FR. DE NEUFCHATEAU.

H. D.

GERMAN.

March 1889.—8—10.

I. Translate into German :—

(*a*) 1. The rivers are deep.
2. The woman says she has become poor.
3. I should not have said it if you had wished.
4. The soldiers have fought bravely.
5. As you (tr. *thou*) have learned German, speak German to me.
6. The pupil has been praised by the teacher.
7. My brother's horse will be sold as soon as he has arrived.
8. These mountains are higher than they seem.

(*b*) A dervise was journeying alone in a desert, when two merchants suddenly met him. "You have lost a camel," said he to the merchants. "Indeed we have," they replied. "Was he not blind in his right eye, and lame in his left leg?" said the dervise. "He was," replied the merchants. "And was he not loaded with honey on one side, and wheat on the other?" "Most certainly he was," they replied; "and, as you have seen him so lately, and marked him so particularly, you can in all probability conduct us to him." "My friends," said the dervise, "I have never seen your camel, nor ever heard of him, but from you." "A pretty story truly," said the merchants; "but where are the jewels that formed a part of his cargo?"

(*c*) Unseen :

THOMAS À BECKET'S MOTHER.

It is related that the father of Thomas à Becket accompanied the Crusaders to the Holy Land, and was there taken prisoner by a Moor of high rank. He was confined in the castle of his captor, whose beautiful daughter, captivated

by the personal attractions of the young Englishman, took pity on his unfortunate condition, and procured him the means of escaping. Before taking leave of him she had obtained a promise on his return to his native country to send for and marry her. As after a lapse of several years he had sent no news of himself, she embarked for England, and, though not knowing a word of the language except the name of her lover, and of the street where he lived, she succeeded in finding him out. Willingly did Gilbert fulfil the promise he had given of making her his wife.

II. Translate into English :

(*a*) Erschöpft und zitternd setzte Peter seinen Weg fort ; der Pfad wurde steiler, die Gegend wilder, und bald *fand* er sich an der ungeheuren Tanne. Er machte wieder wie gestern seine Verbeugungen gegen das unsichtbare Glasmännlein und *hub* dann an :

" Schatzhauser im grünen Tannenwald,
Bist schon viel hundert Jahre alt.
Dein ist all' Land, wo Tannen stehn,
Lässt dich nur Sonntagskindern sehn."

" Hast's zwar nicht ganz *getroffen*, aber weil du es bist, Kohlenmunkpeter, so soll es so *hingehen*," sprach eine zarte, feine Stimme neben ihm. Erstaunt sah er sich um, und unter einer schönen Tanne, *sass* ein kleines, altes Männlein, in schwarzem Wams und roten Strümpfen und den grossen Hut auf dem Kopf. Er hatte ein feines, freundliches Gesichtchen und ein Bärtchen, so zart wie aus Spinnweben ; er rauchte, was sonderbar *anzusehen* war, aus einer Pfeife von blauem Glas, und als Peter näher *trat*, sah er zu seinem Erstaunen, dass auch Kleider, Schuhe und Hut des Kleinen aus gefärbtem Glas bestanden ; aber es war geschmeidig, als ob es noch heiss wäre, denn es schmiegte sich wie ein Tuch nach jeder Bewegung des Männleins.

HAUFF : *das kalte Herz.*

III.

1. Give the principal parts and the 2nd pers. sing. pres. ind. of the verbs in italics :—*Fand, hub, lässt, getroffen, hingehen, sass, anzusehen, trat.*
2. Account for the construction in weil du es bist . . . so soll es . . . was sonderbar war . . . and the concord of *er* in : er hatte ein feines, &c.

3. Decline sing. and pl. : das unsichtbare Glasmännlein ; eine zarte feine stimme.
4. Distinguish between *es ist* and *es giebt*, with instances.
5. Distinguish between *Laden* and *Läden ; Bande* and *Bänder ; Worte* and *Wörter*, with instances.
6. Give the prepositions which govern the genitive.

IV. Unseen :

Dundee, 14 März 1889.

Herren C. RUSSEL, Liverpool.

Haben Sie die Güte, für meine Rechnung die Versicherung auf £2,800, den vierten Theil der Brigg Niagara, Kapitän P. Wilton, von Boston nach hier bestimmt, gegen alle Gefahr und zu der möglichst niedrigen Prämie zu besorgen. Ich hoffe Sie werden dieses Risiko zu 6 bis 8% unterbringen können, gestatte Ihnen aber nötingenfalls bis 10% zu geben.

Ferner ersuche ich Sie, auf £950—Wert von 95 Ballen Baumwolle, jeder Balle zu £10, zu Boston für meine Rechnung an Bord der Brigg Niagara verschifft, die Versicherung gegen alle Gefahr zu besorgen.

Indem ich darauf rechne dass es Ihnen gelingen wird die Versicherung von $1\frac{1}{2}$—2% zu bewirken, will ich Sie jedoch nicht an diese Prämie binden. Das Schiff sollte ungefähr am 10ten d. M. absegeln.

Hochachtungsvoll,

J. BERNHARD.

V. Unseen :

"Soll der Funke des Lebens nicht gleich nach unserer Geburt weider verlöschen ; soll unser schwacher Körper sich stärken und ausbilden ; sollen wir Alles werden, Alles leisten, Alles geniessen, wozu wir erschaffen sind : so bedürfen wir unserer Brüder, so muss ihr Arm uns schützen, ihr Wohlwollen uns pflegen, ihre Weisheit uns leiten : so muss ihr Beispiel uns zum Guten entflammen und ihr Umgang uns Freuden und Vortheile gewähren : so müssen wir die Mitglieder eines Bundes sein, wo Alles auf das genaueste zusammenhängt."

REINHARD.

VI. Translate into English :

HOCHZEITLIED.

Da kommen drei Reiter, sie reiten hervor.
Die unter dem Bette gehalten ;
Dann folget ein singendes, klingendes Chor
Possirlich kleiner Gestalten ;
Und Wagen auf Wagen, mit allem Geräth,
Dass einem so Hören und Sehen vergeht,
Wie's nur in den Schlössern der Könige steht :
Zuletzt auf vergoldetem Wagen
Die Braut und die Gäste getragen.
So rennet nun Alles in vollem Galopp
Und kürt sich im Saale ein Plätzchen ;
Zum Drehen und Walzen und lustigem Hopp
Erkieset sich jeder ein Schätzchen ;
Da pfeift es und geigt und klinget und klirrt,
Da ringelt's und schleift und es rauschet und wirrt,
Da pispert's und knistert's und flistert's und schwirrt ;
Das Gräflein, es blicket hinüber,
Es dünkt ihn als läge er im Fieber.

GOETHE.

H. D.

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